AIR ENGINEERING

SEPTEMBER, 1959

AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

- *Garlock Finds Solution to Duct Fires*
- *Simple Steps to Fan Selection for Non-Standard Air*
- *Analysis of Make-up Air Heaters . . . Which One To Use Where*
- *How Pennsylvania Power Stops Fly Ash*

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AIR | ENGINEERING

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AIR ENGINEERING

VOL. 1, NO. 6

SEPTEMBER, 1959

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DEDICATED TO THE SCIENCE OF AIR POLLUTION CONTROL
AIR MOVING • AIR CONDITIONING

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THE COVER

This month's cover, which so aptly portrays the scope of AIR ENGINEERING in air pollution control, industrial ventilation, industrial air conditioning, is from the May 28 cover of *THE REPORTER* magazine. The cover is by artist Herbert Danska, and is an impression of steel plants.

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Letters

To Cap or Not To Cap

Editor:

Many thanks for the proof letter of A. G. Mutimer in regards to stacks and capping of stacks, July issue AIR ENGINEERING, page 47. *(See Mr. Mutimer's letter on page 2, August Issue.)*

I'm sure that Mr. Mutimer's views on the above created quite an interest in many industries, as it did here at Zippo.

With roof mounted exhaust fans and horizontal intake (as picture shows) I quite agree with Mr. Mutimer; and why Zippo installed the caps where none are needed in this installation is possibly why a crowd of people stare up into the sky where one person starts it.

In some installations caps may help to keep rain and snow from entering the stack and finding its way out the joints or seams of the stack. While no caps at all may be OK for southern climates, I'm not so sure that the heavy snow storms we have (usually at night when the blowers are not running) would find us unable to start the fan next morning.

However, we do appreciate Mr. Mutimer's comments and they no doubt require a further study; and possibly a trial to evaluate the action in our climate.

L. Flickinger
Vice-President of Production
Zippo Manufacturing Co.

Editor:

AIR ENGINEERING is a fine paper. Please send tear sheets of the article on Dow Chemical Company's incineration system.

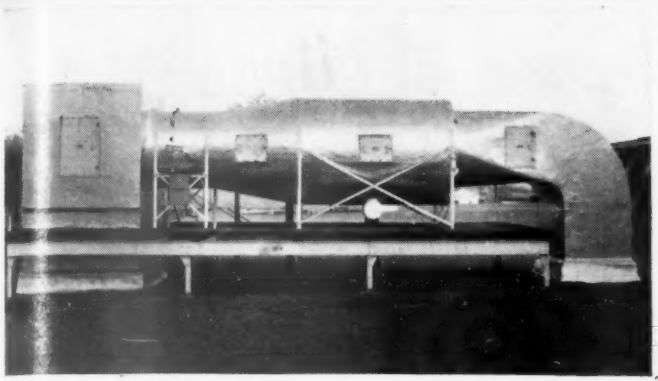
L. P. Morris, P.E.
Engineer
American Cyanamid
Bridgeville, Pa.

Editor:

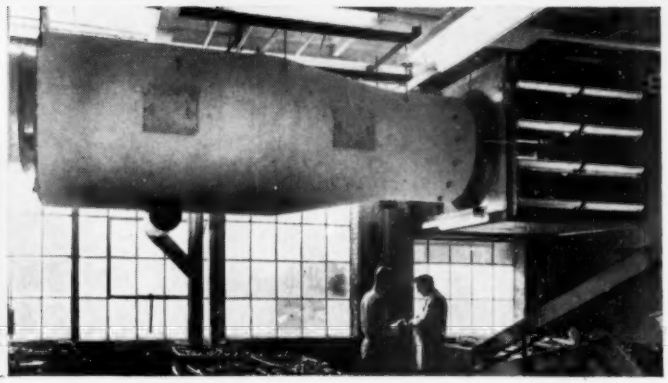
Issue No. 2 of 2 received with much appreciation. Your magazine is excellent and should prove invaluable to the consulting engineer.

A. Merrill Beck, Jr.
Partner
Armistead & Beck,
Consulting Engineers
Norfolk 10, Va.

(Please turn to page 6)

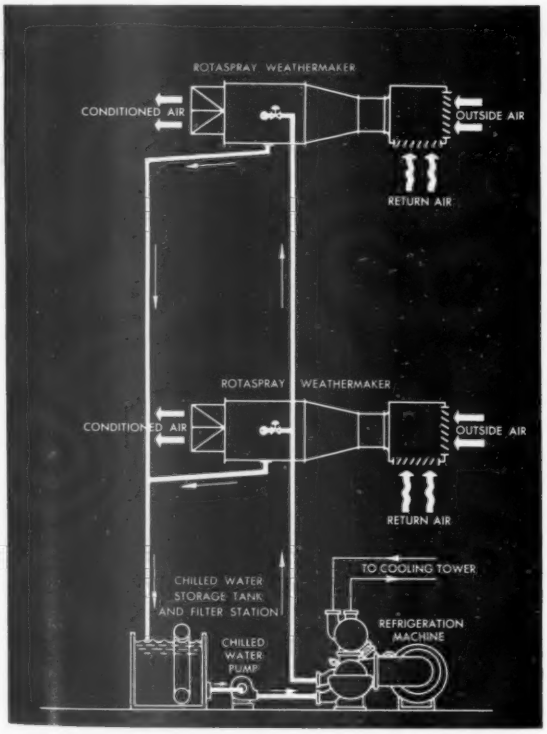


Roof-top Rotaspray installation



Ceiling-mounted installation

Major breakthrough in industrial air conditioning...



Rotaspray units are self-cleaning, and require no filters. A single refrigeration machine with chilled water storage tank and filter station will handle a multiple unit system with units located at many remote points. Each unit provides individual control of temperature and humidity.

THE CARRIER ROTASPRAY WEATHERMAKER SYSTEM*

This revolutionary new Carrier air conditioning system is now available to all industrial plants. Its superiority has been proved by four years of field operation on many different installations. Compared with past systems, it provides better control, it lowers construction and maintenance costs —and occupies less space. The Rotaspray is the first major advance in air washer design in half a century.

Operating at high air velocity (2600 fpm) Rotaspray units are only ⅓ as large as conventional air treating apparatus for the same capacity. Furthermore, they can be located out of doors, with no protective shelter. For system arrangement, note the diagram at left.

Each Rotaspray unit is made of stainless steel for long life. Each provides superior control of temperature and humidity, and offers unequaled ability to meet load variations in the area it serves. Units are compact and light, can be hung from the ceiling, put on the roof or suspended outside on the wall. Five sizes: 10,500 to 45,000 cfm.

For complete information on this new system, call the Carrier office near you. Or write Carrier Corporation, Syracuse, New York.

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REPRESENTATIVES IN PRINCIPAL CITIES

Letters

(Continued from page 4)

Time Runs Out on Inefficient Incinerators

Editor:

I have read with a great deal of interest and almost complete agreement the clip sheet *(see editorial on page 5 of August issue)* of your August editorial. My comments follow:

I cannot agree with the statement made in your tenth paragraph that we have inadequate municipal incineration facilities. Nearly all of our combustible waste is centrally incinerated. Our program for new incinerators is continuing but in most cases these replace older, smaller, and less efficient incinerators.

I feel that the time is at an end when inefficient municipal incinerators, designed and operated with little or no regard for controlling the air pollution, will be acceptable to the general public.

I also believe that the manufacturers of smaller incinerators, both destructor and flue fed type, must mend their ways by designing and marketing incinerators which will reduce the refuse without creating a nuisance or exceeding established limits for chimney emissions. This can be done, although not without spending money both for designing and developments, as well as for refinements in the incinerator itself.

Finally, it is my firm conviction that refuse may be disposed of most economically by collection from the sources and reduction in efficient central incinerators.

Mr. Flood *(chief engineer)* joins me in my comments on the editorial.

Leonard Greenburg, M.D.
Commissioner
The City of New York
Department of
Air Pollution Control
New York 38, N. Y.

Editor:

Please send University of Toledo Research Foundation Report on Contamination effects of exposed water on coils and Humidifiers, as shown on page 26 of this first issue. Also other information on Kathabar system.

A. A. Jennings, Engineer
Sampson Scientific Company
Chicago 12, Illinois

AIR ENGINEERING

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EDITORIAL:

Controlled Air Controls Disease ■ ■ ■

"I FEEL IT IN MY BONES," Grandpa used to say. And he was right. The human body is a natural barometer.

Rheumatism and arthritis, for example, tend to flare up prior to the arrival of storms or low pressure air masses. Attacks of asthma, angina pectoris, glaucoma, and migraine headaches also *precede* and (in a sense) tend to *predict* atmospheric changes.

Climate influences body functions, and affects health, obviously. And "climate," of course, can be manufactured. Indoors, that is. Maybe outdoors some time, too!

Our Earth's temperate zone (in which most subscribers of this publication live) has sharp seasonal weather variations. These ups-and-downs either havoc or stimulate metabolism and other adaptive mechanisms of the human physique.

Physicians believe that this fact is a major reason for the greater vigor, energy, and achievement of northern hemisphere (North America and Europe) residents. As a side effect, the human engine, which runs hotter and faster in the North, breaks down sooner in the area we inhabit. The higher the pressure under which you work, the greater the energy output and worry intake – and the shorter your life, apparently.

Heart attacks are commonest in Europe and the U.S.A. Metabolic diseases, arthritis, diabetes, ulcers, cancer – also are amongst our chief obstacles to a long and active life. Temperature extremes of all kinds appear to precipitate heart attacks, incidentally. For instance:

In Dallas, Texas, most coronaries occur in July and August, when the daytime thermometer reading commonly exceeds 95 degrees. Contrastingly, in Milwaukee heart attacks are commoner in sharp midwinter.

High humidity increases pulmonary embolism, during which clots that have formed in deep veins break loose and migrate disastrously to the network of blood vessels in the lungs. Doctors explain that a "storm" somehow shakes loose these clots, which might have remained stationary and peaceful in calmer weather.

Seasonal nature of many diseases is accepted scientifically, although *why* and *how* temperature and humidity extremes are lethal still isn't known. Why, for instance, do poliomyelitis epidemics coincide with hot weather? Measles is a warm weather disease, too. Again, the reason is unknown. Whooping cough is climate-affected, also.

Researchers suspect that hot, humid atmosphere multiplies the virulence of many germs and augments the susceptibility of those stricken.

Quite a few of the most debilitating diseases are especially endemic in the tropics. Malaria, cholera,

(Please turn to page 12)

NEW KIRK & BLUM

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52 pages showing 60 different installations in major industries

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See how Kirk & Blum provides one source for the complete operating system—design, fabrication, installation—*one* undivided responsibility.

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Letters

(Continued from page 6)

Editor:

May we hasten to add our belated congratulations on your new publication, AIR ENGINEERING, of which we have received complimentary copies from an unknown donor—and many thanks to whoever it may be. We know that you will make a fine contribution in this field of growing complexity.

A. L. Anderson
Hankins and Anderson
Consulting Engineers
Richmond, Virginia

Editor:

We have just received our first copy of your magazine AIR ENGINEERING and have come across the article THE MEANING OF "CLEAN AIR." This article is of particular interest to us, and we would appreciate your forwarding to us the first two parts as our magazine carries part three. The article was written by Robert H. Avery.

Abbott Feindel
Chief Engineer
Tung-Sol Electric, Inc.
Washington, N. J.

Editor:

I have read with great interest the article on the air conditioning of our new building that was carried in the July issue of AIR ENGINEERING *(page 20)*.

In our opinion, it is one of the finest presentations of this type that we have ever seen and, as representative of the Owner of the Kroger Building, greatly appreciate all of the hard work that has gone into the preparation of the article.

W. H. Anderson
General Manager
The Kroger Building
Cincinnati

Editor:

Please forward 30 of the subscription cards similar to the enclosure. We want to circulate these to Manufacturers' Representatives selling our wet type dust and fume scrubber, for we believe that your magazine would be very helpful to them.

E. B. Henby
Vice President, Sales Manager
National Dust Collector Corp.
Chicago

Automated Post Offices Get Air Conditioning

Installation of the new "Mail-Flow" automatic postal handling equipment will bring the additional benefit of air conditioning to Cleveland's Main Post Office. Says Postmaster Joseph S. Frantz, we asked for air conditioning because the new automation equipment which takes up three floors, blocks off air flow from open windows. Other post offices recently fully air conditioned are in Kalamazoo, Mich., and Birmingham, Ala.

Mayor Bucks Municipal Incinerator

Saskatoon, Sask. Mayor Sid Buckwold bought the first home gas-fired incinerator in the Sasketchewan Power Co.'s drive to have a garbage burner in every home. The mayor pooh poohed air pollution problems from mis-use of the units, said municipal garbage pick-up and disposal is too costly. The power company has contracted with Majestic Co., Huntington, Ind., to supply the incinerators.

Man Becoming Obsolete? Could Be, Says U.S.P.H.S.

Dr. David E. Price, Assistant Surgeon General of the U.S. Public Health Service, asks "Is man becoming obsolete?"

Price says there are grounds for fearing mankind may be committing suicide because "the inventions of clever men threaten survival of the species. In a recent issue of Public Health Reports, Price discusses the menace of man-made radiation, man-made contamination of the air and the increasing use of chemical poisons in agriculture and industry. Says Price: "Organic materials of unknown toxicity are being introduced at an ever-accelerating pace." He warned about the long-range effects of air poisoning through contaminants from industrial sources.

Pundits Active In Air Conditioning, Air Pollution

In addition to Dr. Price (see above) other pundits have recently made remarks of interest to air engineers. Self-admitted dreamer and Scripps-Howard syndicate feature writer Andrew Tully asked Dr. Francis W. Reichelderfer, chief, U.S. Weather Bureau if cities could ever be air conditioned. Says Dr. Reichelderfer: "It's not a difficult problem to dope out by physics. All you do is pump out the hot air or cool it off. But nobody could afford it." He estimated it would cost millions of dollars a day to air condition Washington, D. C. The doctor pointed out that even a half mph wind would blow away the chilled air so the city would have to be enclosed with glass walls and a glass roof.

And Senator Richard L. Neuberger (D., Ore.) has introduced legislation to require the U.S.P.H.S. to set a maximum allowable concentration of emissions from gasoline and diesel engine truck exhausts as related to human health. Neuberger, a professional writer, said the solution to the auto exhaust problem cannot "be left to the caprices of auto designers, who seem more concerned with fins than fumes."

Teeth in the Senator's legislation would outlaw use of automotive equipment in interstate commerce which violate the to-be-established MAC's.

Waiting In California . . . A $450,000,000 Market for Auto Afterburners

Soon as someone perfects them, a ready-made market is begging for 7-million auto afterburners to end smog in Southern California, says the Air Pollution Foundation. The market will stand a cost of $50.00 each for the muffler replacements, plus installation cost plus $20-yearly maintenance costs, according to the Foundation.

Another solution for the auto-smog problem, said the Foundation, is an engine modification, now under development, that looks particularly promising. Lab tests have indicated that this modification not only eliminates smog-forming hydrocarbons but could cut operating costs markedly.

Dust Collection . . . A $500,000,000 Industry?

Extent of industry's efforts to reduce air pollution and recover useful materials and the vast sums expended by industry for that purpose is not generally appreciated, says James M. Knox, president, Research-Cottrell, Inc.

"Industry currently is spending an estimated $500,000,000 annually for control equipment, personnel and research; and every prediction indicates that industry will substantially boost this budget in the future," Knox states.

Joy and Western Precipitation Swap Stock

Joy Manufacturing Co., Pittsburgh and Western Precipitation Corp., Los Angeles, announced that Joy will acquire Western's net assets through an exchange of stock, subject to approval by Western's shareholders.

Transaction will involve 77,300 shares of Joy common shares at the rate of one Joy share for each 2¼ shares of Western. Transaction covers stock valued at about $4-million.

Western sales are understood to have totalled about $9.5-million in 1958 and $12.3-million in 1957.

Announcement of the stock transaction was accompanied by a statement by managements of both concerns that Western's important position in dust collection will be a logical and strong link in Joy's service to the growing market for the compression, movement and cleaning of air and industrial gases.

$10-million Earmarked To Help Cities Beat Air Pollution

In Washington recently the House passed and sent to the Senate a bill extending for another two years Federal assistance to combat air pollution problems in metropolitan areas.

The bill authorizes an outlet of $5-million in Federal funds for each of the two years, starting July 1, 1960. Money will go to finance a Federal program of research and technical assistance in the field of air pollution. Research will include studies of pollution from auto and truck exhaust fumes.

This program, operated by the Health, Education and Welfare Department under the surgeon-general of the U.S. Public Health Service, for the past five years, expires June 30, 1960.

Kennecott Tests Experimental Dust Collector

At its secondary crushing operation at Utah Copper Division Magna Mill, Kennecott Copper Corp. is testing an $84,000 experimental dust collector. Unit, about one-tenth the size of comparable units, is designed to improve in-plant working conditions in mining, milling and smelting operations. Collector is installed in the duct system, is a water spray, impingement type.

Climate by Chrysler

tames Houston's heat at Dresser Electronics Center!

"We'd need 2,400 *tons* of ice—every day—to cool the eight buildings in Dresser Electronics Center*. It takes just *four* Chrysler Centrifugal Units to do the job. And, with Climate by Chrysler, we get many other important benefits, besides.

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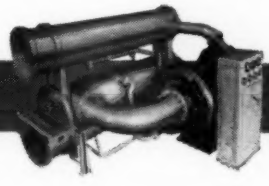
"Since our equipment operates winter and summer, safety is vital, too. So each of our Airtemp centrifugal units is complete with automatic purge system, oil and temperature control, and other special protective devices."

Whether your air conditioning job requires 30 tons, or 3,000—it will pay you to get the Chrysler story. Contact your local Chrysler Applied Machinery and Systems sales office. Or write: Airtemp Division, Chrysler Corporation, Dept. AA-99, Dayton 1, Ohio. In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario.

*New Houston, Texas, home of Southwestern Industrial Electronics Co., a Division of Dresser Industries. Shown above: E. L. Andrews, Facility Director for Dresser Industries, Inc. *Consultants:* Bernard Johnson & Associates. *Architects:* Pierce & Pierce. *General Contractor:* Tellesten Construction Co. *Mechanical Contractor:* Natkin & Co.



CHRYSLER AIRTEMP

FIRST WITH THE FINEST IN AIR CONDITIONING

NEWS of the Industry

NYC Projects Gobble Air Moving Equipment

Some of the most extensive air moving equipment ever to be installed in this country has gone into the air conditioning systems in two new modern buildings in New York City—the Chase Manhattan Bank in lower Manhattan and the Time & Life Building located in the Radio City project.

The Westinghouse blower equipment installed in the Chase Manhattan Bank includes 100 Series 8000 "Airfoil" fans, 24 air handling fan sections and various ventilating sets and air handling units. This equipment supplies 2 million c.f.m., returns 1¾ million c.f.m., and exhausts 50,000 c.f.m. Total air conditioning system cooling capacity is 9,000 tons.

The Time & Life Building includes 162 Series 8000 Airfoil fans, 57 unit heaters, and a few ventilating sets. These fans supply 1,370,000 c.f.m., return 1,200,000 c.f.m., and exhaust 60,000 c.f.m. Cooling capacity of the system is rated at about 6,000 tons.

Positive Air Pressure Guards Missile Relays

A building that will include an area in which a positive internal air pressure will be maintained, in order to meet the growing space-age demand for completely reliable missile and aircraft components, marks the addition to the U.S. Relay-Electronics plant in Azusa, Calif.

Most of the attention in the plant design centered on methods of preventing dust or any other contaminant from entering the "Non-contaminate Series" hermetically sealed relay enclosures which the A-S-R Products Corp. division of the company produces for use in aircraft and missiles.

The 12,000 sq. ft. manufacturing area has been provided with an elaborate system of temperature, humidity, and dust controls. To further prevent dust particles from entering, air movement is always maintained outward from the assembly area by raising the internal air pressure substantially above the outside air pressure.

To ensure these pressure differentials, pressure gauges and alarms are installed between each protected area. Furthermore, the temperature and humidity are recorded on 24-hour circular charts which are also equipped with built-in alarms.

Periodically the air within the assembly area is sampled and the dust content measured.

Newsweek Asks: 'Fumes Key to Cancer?' Cites U. S. Public Health Service Survey

National magazines continue to give intensive attention to the subject of air pollution and its effect upon public health. In the "Medicine" section of its Aug. 17 issue, *Newsweek* headlined "Fumes—Key to Cancer?" and the article said, in part:

"The picture the statistics conjured up seemed incredible: If the yearly accumulation of airborne dirt above a typical industrial city were to settle to the earth at once, the residents would perish beneath 21 feet of filth. Impossible as this might be, health authorities say the mere presence of such pollution is cause for grave concern. . . .

". . . The perilous cloud of contaminants shrouds the nation's big cities and threatens the health and happiness of 76 million city folk, or 43 percent of the population. What happens to the human body when this 'gunk' passes through the lungs, hour after hour, year after year? Just how great is the air pollution hazard to health? More specifically, as has often been suggested, is there a link between air pollution and lung cancer. . . .

". . . In a U.S. Public Health Service air control study, now in its second year, samples of air in eight cities—Atlanta, Birmingham, Detroit, Cincinnati, New Orleans, Philadelphia, Los Angeles, and San Francisco — have been chemically broken into four fractions of hydrocarbons to determine which causes the most cancer when injected into laboratory animals. ' ' '

"Among those conducting this research is Dr. Paul Kotin of the University of Southern California School of Medicine, who has spent more than eight years in air-pollution-cancer research. Kotin, a pathologist, blames the increase in lung cancer on air pollution from gaso-

Editorial (Cont.)

Controlled Air Controls Disease

(Continued from page 7)

and streptococcus respiratory infections join up with dysentery to make non-air-conditioned living a frightful hazard in the Tropic Zones.

Recent British studies indicate that humidity is an important factor in air-borne epidemics, such as Asian flu – both in the tropics and in temperate zones. Influence of heat on air-borne contagious diseases also has been observed.

Moreover, the effect of weather on human behavior is striking, even though mysterious. Restlessness, inability to concentrate, and irritability often are observed before a storm. This is particularly noticeable in mental hospitals.

Control the climate (temperature, humidity, pure air) and maybe we can control disease!

Progress of AIR ENGINEERING (not only the profession – the magazine, too) probably will help to prolong life. Surely it can enhance human happiness by helping to conquer disease and by "souping up" personal vigor.

People in this business, thereupon, can believe that almost everything they do commercially is a contribution to the advancement of human welfare. ▲▲

line—'the time-honored cancer-producing chemicals, tars and organic hydrocarbons.'

"Even when the powerful chemicals found in gasoline do not produce cancer, they can seriously weaken the linings of the lungs, Dr. Kotin pointed out. Later, the atmospheric irritants may play a role in the development of lung cancer by interfering with the normal flow of mucous in the lungs. 'The mucous stagnates, and cancer-producing chemicals get into the lung cells and start what we believe to be the cancerization process.'

"'Kotin and his associates, who have studied lung linings 'in every mammal from mouse to steer,' regard this discovery as a 'major breakthrough' in air-lung-cancer research. 'The next link in our chain is the effect of the chemical agent on the cell'."

New Dust Measuring Devices Introduced

Two new types of dust measuring devices for laboratory and industrial applications have been introduced recently.

Eastman Kodak Co. has been granted a patent for a dust meter said to be capable of detecting a puff of cigarette smoke blown into a room 10 by 15 ft., or a few thousandths of an inch of fine dust—enough to cover the head of a pencil—dispersed in the same size room.

Air to be tested is drawn by a vacuum pump through a small opening and against the surface of a slowly moving transparent or translucent sheet. Dust deposited on a sheet makes a track that can be watched as it forms. A beam of light is focused through the opening and through the moving sheet.

An instrument called a densitometer compares the density of the dust track with a standard representing the permissible maximum, and a continuous record may be kept.

To check the amount of beryllium dust in the air a new type of instrument was introduced by National Spectrographic Laboratories, Inc., Cleveland. Beryllium is a material of considerable toxicity which is being used more and more in industry. In addition to finding use among beryllium fabricators, smelters, and users, it may also find uses in many other fields, states D. R. Moore, vice president of sales for National Spectrographic.

"Big power plants might use it to monitor the air for mercury," he points out. "Insecticide manufacturers could use it to guard against arsenic. Paint and battery manufacturers and mining and smelting companies could use it for such materials as lead."

The instrument keeps a permanent record of the amount of toxic material in the air. A horn-shaped device that looks like a hearing aid sucks the air inside the instrument and through a piece of filter paper tape. A spark is used to burn the filter paper away, and a spectrometer measures the amount of toxic material, such as beryllium, by the light it gives off.

SatevePost Reviews Fallout Danger

The two-part article "Fallout: The Silent Killer" which the *Saturday Evening Post* published in August, was an exhaustive treatise on the pros and cons of the debate about whether radioactive fallout from A-bombs and H-bombs is endangering the health of this and future generations. Its conclusion:

"Radioactive fallout is a silent killer which hides its poisons among the more familiar causes of human illness and death, and thus postpones positive identification. Its damage to our hereditary endowment may take generations to make itself felt. But there will be a cost, a heavy cost in disease, deformity, and early death for many yet unborn."

Curiously missing from the article is any discussion of how some prevention or mitigation of the results of radioactive fallout could be achieved through filtration.

Ask Jail Terms for Third Time Violators

They're getting tough in Toronto. One member of that city's Works Committee proposed jail terms for third-time violators of the air pollution ordinance.

And standard penalty right now is $50 for first offense, $100 for second, $200 for third.

Correction

To get the correct view of the heat treat fan on page 32 of the August issue, turn the page upside down. Upending a furnace of this size is quite a trick, but we made it. Our regrets to Author Lynch for adding this discordant note to his fine article.

States, Cities Act On Air Problems

Here's what the States, and cities within these States, are doing about air conditioning, air pollution control and air pollution surveys:

In California, Los Angeles Building and Safety Committee is to decide soon whether or not mechanical engineers should sign plans for larger heating and air conditioning work before a permit is granted by the city. The plan signing proposal is supported by Mechanical Contractors Association, Associated Plumbing Contractors and engineering societies. Opposing the plan are Refrigeration and Air Conditioning Contractors Association of Southern California and Sheet Metal Contractors Association of Southern California, it was reported.

A crackdown on diesel trucks with faulty exhaust systems in the San Francisco Bay was proposed by a chairman of the Bay Area Air Pollution Control Board. Proposal would require police cooperation in nailing the offending trucks.

California will be assisted by the Federal Government in drafting air and auto exhaust pollution standards. Public Health service is to provide consultation, technical assistance in drafting these standards.

In Washington, the first intensive air pollution survey ever held in the state has begun in Spokane. Survey, by the state health department, will cover all phases of air pollution from weather conditions to fuel usage. Study will include data on population, topography, meteorology, sources of pollution from industry, commercial and domestic activity.

In Illinois, Governor Stratton vetoed a bill to appropriate funds from a State Air Pollution Study and Investigation Committee.

In Michigan, the Detroit Air Pollution Control Department has successfully enlisted cooperation of the city police department in ticketing vehicles for offending smoke emission. Tickets issued by police totalled 2700 for 1958, an almost 100 percent rise over the previous year.

In Virginia, legislation to set up an air pollution control agency within the Virginia State Health Department was called for by the agency in its monthly publication, Virginia Health Bulletin.

Pollution Complaint$

Where there's a pollution problem there's a market for equipment to solve that problem . . . dust collectors, scrubbers, precipitators, blowers, other equipment.

Each month we plan to summarize air pollution situations in cities across the land as a service to equipment manufacturers.

We also plan to follow-up directly with each company involved to cover the solution to their problem as a service to our readers.

Toledo, Ohio—City council recently heard protests by a group of West End area residents against pollution of air by Central Rubber and Steel Co.'s Western Ave. plant. Council was told that freshly painted houses have been damaged, children covered with soot and dirt after a short time outside, and that autos cannot be kept clean. City solicitor, Russell Rakestraw, informed council that the city has no smoke abatement ordinance covering such situations and that if the citizens' group and the company cannot work out a solution, court action would have to be taken by the petitioners.

• • •

Troutdale, Ore. — Oregon Supreme Court has held that Reynolds Metals Co. must pay $91,500 to a farm couple for aluminum plant fume damage to their stock farm. The court upheld a circuit court award to Mr. and Mrs. Paul Martin, whose 1500-acre farm is a half-mile from the company's reduction plant at Troutdale.

The Martins have already been paid $85,427 by Reynolds on judgments entered in 1954 and in 1955 on other suits, a company spokesman said.

Martin has alleged damage to their own health as well as to farm and livestock. Court said there was ample evidence to show fluoride emissions from the plant caused $91,500 damage to land's use for grazing and in deterioration.

A company spokesman said that since 1946 Reynolds has spent $6,500,000 for installation and operation of equipment to control fumes from its Troutdale and Longview (Wash.) reduction plants.

The company has been the target for many farm damage suits over the fluorides which farmers said affected animal bones and teeth, made pastures dangerous and even pitted window glass. Courts in 1952 and 1954 denied claims of 29 plaintiffs who asked a total of $1,650,000 and awarded $163,652 to 47 plaintiffs.

Also at Troutdale, Fairview Farms, Inc., operating a 158-acre dairy farm northwest of the city, has been judged entitled to damages from Reynolds Metals Co., according to U.S. District Judge William G. East.

The dairy estimated damage by reason of decreased milk production due to consumption of fluoride contaminated forage by cows, at about $500,000. Damages to be awarded will be determined at a future date.

A major point at issue in the 41-day trial of this case was whether fumes deposited on the land, with their poisonous fluorides, constituted a nuisance or a trespass. If a nuisance, dairy would be entitled to damages for only two years previous to date of filing of suit; if a trespass, period for which damages could be collected would be at least six years, according to the Judge. The ruling: a trespass, but that the dairy's land had not been depreciated in value by reason of the trespass and that plaintiff's plea for an injunction against possible continuation of the trespass should be denied.

• • •

Endicott, N. Y.—Officials admitted that no solution to the soot fallout problem is in sight, since it would cost one major industry, presumably Endicott-Johnson Co., about $1,000,000 to convert their coal burning boilers to a "cleaner fuel." Mayor E. Raymond Lee, who declined to name the firm, said it would cost $700,000 to $1,000,000 to convert the boiler plant of the firm involved. Remarks were made in a report to village trustees.

• • •

Detroit—Chrysler Corp. is studying ways and means of eliminating fumes from electric furnaces in their Dodge, Winfield Rd. plant.

Meetings, Courses, Expositions

U. S. Public Health Service training course in community air pollution, *Robert A. Taft Sanitary Engineering Center, Cincinnati, Sept. 21-Oct. 2.*

Instrument Society of America, 14th annual Instrument-Automation conference and exhibit, *International Amphitheatre, Chicago, Sept. 21-25.*

American Institute of Chemical Engineers meeting, *St. Paul hotel, St. Paul, Minn., Sept. 27-30.*

Federation of Sewage & Industrial Wastes Association meeting, *Statler-Hilton hotel, Dallas, Oct. 12-15.*

American Public Health Association 87th annual meeting, *Convention Hall, Atlantic City, Oct. 19-23.*

National Society for Clean Air, Diamond Jubilee International Clean Air Conference and Exhibition, *London, England, Oct. 20 to 23.*

Oil Heat Institute of America, Inc., board of directors meeting, *The Homestead, Hot Springs, Va., Oct. 28-30.*

Association of Consulting Chemists and Chemical Engineers meeting, *Biltmore hotel, New York City, Oct. 28.*

Industrial Hygiene Foundation annual meeting, *Mellon Institute, Pittsburgh, Oct. 28-29.*

Air Conditioning and Refrigeration Institute, 11th Exposition of the Air Conditioning and Refrigeration Industry, *Public Auditorium, Atlantic City, N. J., Nov. 2-5.*

U. S. Public Health Service training course in control of particulate emmissions, *Robert A. Taft Sanitary Engineering Center, Cincinnati, Nov. 2-13.*

Institute of Boiler and Radiator Manufacturers semi-annual meeting, *Seaview Country Club, Absecon, N. J., Nov. 9-13.*

U. S. Public Health Service training course in control of gaseous emissions, *Robert A. Taft Sanitary Engineering Center, Cincinnati, Nov. 16-20.*

American Society of Industrial Hygiene annual meeting, *War Memorial building, Rochester, N. Y., April 25-28, 1960.*

Production Engineering Show, *Navy Pier, Chicago, Sept. 6-16, 1960.*

East Central Section, Air Pollution Control Association, *Sheraton-Cadillac Hotel, Detroit, Sept. 22-23, 1960.*

New Appointments

H. W. Gaeckle has been named vice president and general manager of Dracco Div. of Fuller Co., Cleveland. Dracco manufactures dust control equipment and pneumatic conveyors.

H. W. Gaeckle

Gaeckle has been with Dracco for 22 years, and has served as general sales manager since 1950. He is assuming active control of the division from **George A. Gieseler** who has been the chief executive officer of the company for the past 25 years, and will continue on in a senior advisory capacity.

Minneapolis - Honeywell Regulator Co. recently named **Dr. Finn J. Larsen** to the newly created post of vice president in charge of research. Dr. Larsen, while continuing to direct activities at the company's central research laboratories, will provide research program guidance for all company divisions.

Dr. F. Larsen

The company also named:

J. H. Binger

James H. Binger a director. He is vice president in charge of the temperature controls group.

William F. Newbold director of research for Brown Instruments Div. He succeeds **Walter P. Wills,** who has been named technical advisor to the director of engineering, a new post.

Robert A. Wolfe, sales manager for the industrial branch at Pittsburgh. He was formerly branch industrial sales manager at Albany, N. Y.

Edward J. Reulbach, Jr., industrial sales manager at Albany. He was formerly at the New York City branch.

Joseph H. Toifel, industrial sales manager at Columbus, Ohio. He was formerly at Youngstown, Ohio.

Willard T. Smith, formerly branch manager at Pittsburgh, account executive in instrumentation for the steel and other heavy industries.

John F. Kooistra, western regional manager in Los Angeles for Carrier Corp.'s Machinery & Systems Div., has been named to the new post of director of marketing services, with headquarters in Syracuse, N. Y. He will also administer the division's technical service departments.

Robert C. White, product sales manager in Syracuse, will succeed Kooistra in Los Angeles.

R. F. Protiva

R. E. Scheel

Heil Process Equipment Corp., Cleveland, announces the appointment of **Richard F. Protiva** as manager of market development and **Robert E. Scheel** as manager of national branch sales.

Protiva was formerly eastern sales manager for the manufacturer of ventilating equipment and heat exchangers. Scheel was formerly western district manager.

Sylvan L. Hanauer has resigned his position as deputy commissioner of the New York City Department of Air Pollution Control, effective Sept. 1, it was announced by Dr. Leonard Greenburg, commissioner. Hanauer is returning to his private practice as a consulting engineer in New York City.

Recold Corp., Los Angeles, has announced the appointment of **Carl Baumhofer** as works manager. He will plan, organize, direct, and control all production operations of the refrigeration and air conditioning equipment manufacturing firm. He was previously general superintendent for a Los Angeles appliance manufacturer.

C. Baumhofer

Appointment of **Glenn N. Hackett** to the newly created position of director of purchases and traffic for Thompson Ramo Wooldridge, Inc. is announced by Vice President H. A. Shepard.

Appointment of **Frank D. Klein** as product manager for air conditioning products for Dunham-Bush, Inc. was announced by James A. Mulcahey, vice president in charge of sales.

F. J. Klein

Klein was formerly chief engineer for Governair Corp. and was also associated with United States Air Conditioning Corp.

Mulcahey also announced the appointment of **E. Harold Brown** as field sales engineer covering the Buffalo, N. Y. area, of **Robert McCulloch** as sales engineer in the New York City office, and of **Wallace G. Hamilton** as application engineer in the Minneapolis district office.

White-Rodgers Co., controls manufacturer, has appointed **Walter W. Scott** and **Frank Crawford** first members of a new technical advisory group charged with disseminating technical information to the sales force.

W. W. Scott

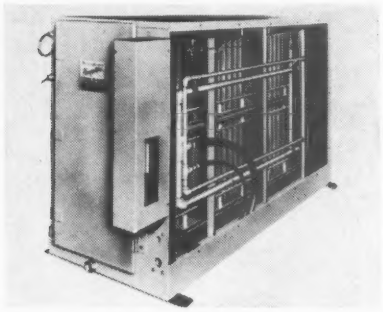
Scott, who will continue to represent White-Rodgers at the American Gas Association offices in Cleveland, will cover Ohio, West Virginia, Michigan, eastern Kentucky, western Pennsylvania, and western New York.

F. Crawford

Crawford will cover New York, New England, Pennsylvania, and the middle Atlantic states, where he was formerly district manager.

White-Rodgers also appointed **James R. Hillin** sales representative in Georgia, Florida, North and South Carolina, with headquarters in Atlanta.

Richard W. Keusink has been named public relations representative for the Western Oil & Gas Association which represents producers, refiners and wholesale marketers of the petroleum industry in six western states. Keusink was formerly director of public relations for McNeil Construction Co.



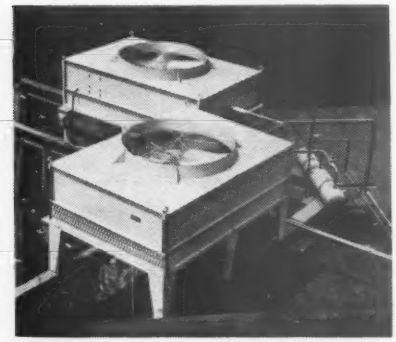
Precipitrons Match Air Distributing Units

New Precipitron® electronic air cleaners now match in style and dimensions Westinghouse air distributing units and can be bolted directly to them to become an integrated system for central plant air conditioning and ventilating.

The air cleaners are designed for application at conventional coil face velocities between 350 and 600 fpm for capacities from 1,950 to 28,800 cfm. They are only 25½ in. deep in the direction of air flow.

Collector plates can be washed either manually or automatically.

Source: *Westinghouse Sturtevant Div., Dept. AE-T-262, 200 Readville St., Hyde Park, Boston 36.*



Vertical Flow Condensers

New line of vertical flow air cooled condensers feature upward draft that directs noise away from nearby structures.

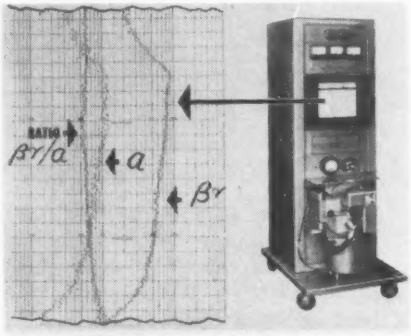
ACV units range in size from 3 to 100 tons. Horizontal mounting of fan and coils spreads roof loading, presents lower silhouette. Performance is not affected by wind conditions. Condensers are mounted on legs to cut down hot roof air drawn in.

Units have "Turbo-Flo" embossed aluminum fins with die-formed collars mechanically bonded to ⅝ in. o.d. copper tubing.

Source: *Halstead & Mitchell, Dept. AE, Zelienople, Pa.*

Monitors Identify Long Half-Life Emitters Immediately

New feature of NMC air monitoring systems permits immediate detection and identification of long half-life predominantly alpha and beta emitters as collection of air borne particles takes place.



It is incorporated in AM-33R moving filter and AM-22R fixed filter air monitoring systems.

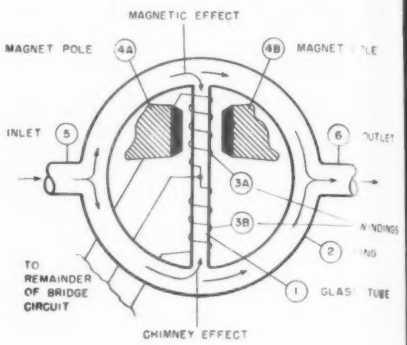
Feature is based on theory that ratio of beta-gamma to alpha activity in natural radon-thoron progeny is essentially constant. Ratio rise indicates presence of long half-life predominantly beta activity; ratio fall indicates presence of long half-life predominantly alpha activity.

Source: *Nuclear Measurements Corp., Dept. AE, 2460 N. Arlington Ave., Indianapolis 18.*

Suppressed Range Oxygen Analyzer

New suppressed range oxygen analyzer has a maximum instrument span of 6 percent and a minimum span of 1 percent when the oxygen content of the gas to be analyzed in 30 percent or less and a minimum span of 2 percent if the oxygen content is greater.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.



It operates in conjunction with an electronic receiver and a sampling system to form a system for analyzing and recording, and/or indicating the oxygen content of a gas on suppressed range application.

Accuracy of the Model 633 is plus or minus 2 percent of scale. Initial response is three seconds, time constant (63.2 percent of final reading) of five seconds. It senses changes of 0.02 percent oxygen.

Source: *The Hays Corp., Dept. AE, Michigan City, Ind.*

Exhaust Shell for Mistkops

New hi-speed exhaust shell that fits all standard Mistkops speeds up filter change. It is made of heavy gauge steel, enamelled in grey tone. Top of the shell is equipped with quick action clamps for fast removal.

Source: *Aget Mfg. Co., Dept. AE, Adrian, Mich.*

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New Literature

Electric Eye Smoke Alarm

Bulletin 553 describes "Electric Eye" unit guarding against smoke circulated by air conditioning system causing panic, hazard, or merchandise damage.

Smoke may enter system from an outside source, recirculated from fire in other parts of system, or from spontaneous combustion in filters. Unit will give split second alarm or shut down circulating fans.

Source: *Photomation, Inc., Dept. AE, 96 S. Washington Ave., Bergenfield, N. J.*

Penn Control Catalog

New catalog of cooling and air conditioning controls, Bulletin 1487-AK, is now available from Penn Controls, Inc.

New listings include line voltage heating and cooling thermostats which supplement several previously cataloged thermostats. Penn's extra heavy duty, two-pole refrigeration controls, designated Series 1272 and 1273, are also shown.

Source: *Penn Controls, Inc., Dept. AE, Goshen, Ind.*

Thermistor Probes

Six-page brochure has been released by Yellow Springs Instrument Co., describing its Thermistemp® thermistor probes.

One section explains technical characteristics of YSI interchangeable probes. Other sections tell advantages of thermistor based temperature measurement and control, and application areas for thermistor instrumentation.

Source: *Yellow Springs Instrument Co., Inc., Dept. AE, Yellow Springs, Ohio.*

Double Retort Underfeed Stoker

Illustrated Catalog No. 401 gives complete data on double retort underfeed stoker. This stoker is built for heavy duty service in the intermediate size range for boilers of about 20,000 lbs. to 34,000 lbs. of steam per hour capacity. Burns nut, pea and slack or crushed run of mine bituminous coals efficiently and without smoke.

Source: *Detroit Stoker Co., Dept. AE, Monroe, Mich.*

Glass Fiber Duct Fans

New line of glass fiber belt-drive duct fans which offer exceptional resistance to most corrosive elements common to industrial plants are described in a new bulletin A-116.

Propeller, duct section, drive housing, and bearing cover on these fans are made of highly corrosion resistant glass fiber; drive shaft and hardware are made of stainless steel.

The fans are available in 20, 24, and 28-in. diameters, with a variety of drives.

Source: *Hartzell Propeller Fan Co., Dept. AE, Piqua, Ohio.*

Titanium Fact File

A 24-page "Fact File" on titanium and titanium alloys has just been published by Mallory - Sharon Metals Corp.

The new booklet contains sections on titanium's high temperature performance, corrosion resistance, erosion resistance, titanium properties, metallurgy, machining, fabrication, welding, testing, Mallory-Sharon quality and control technical services, along with a list of the alloys and mill shapes available.

Detailed tables are included in the corrosion section. The machining section discusses turning, milling, drilling, tapping, grinding, bandsawing.

Source: *Mallory-Sharon Metals Corp., Dept. AE, Niles, Ohio.*

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.

Low Pressure Air Conditioners

New 8-page illustrated 2-color brochure (Bulletin 9127) describes the new, improved line of American Blower low pressure Inductor® air conditioners for perimeter air conditioning of multi-room buildings.

It describes and illustrates the Inductor units and their outstanding construction and operating features. Extensive tabular data presents heating coil capacities, gravity heating capacity, hot water and steam heating capacity factors, and water friction for various delivery volumes.

Installation type drawings are used in conjunction with tabular references to provide complete outside dimensional data for all units. A simplified installation drawing of a typical constant volume low pressure cooling system shows how Inductor units are used.

Source: *American-Standard Industrial Div., Dept. AE, Detroit 32, Mich.*

Peaceful Uses of Atomic Energy

Part of a 33-volume English edition of the proceedings of the Second United Nations' International Conference on the Peaceful Uses of Atomic Energy are "Health and Safety: Dosimetry and Standards" and "Experience in Radiological Protection."

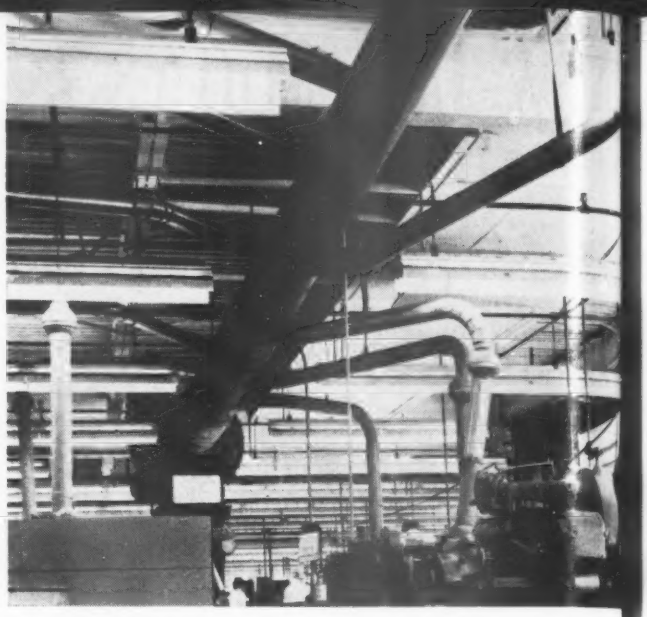
The former covers operational experience in health and safety; standardization and international comparison; high level, chemical, neutron, and medical dosimetry; and dosimetry by thermoluminescence. It is priced at $10.50.

The latter covers experimental therapy and recovery, biological contamination, natural environment, occupational hazards, and protection regulations. Price $14.50.

Source: *United Nations, Sales Section (PUAE, Room 814), Dept. AE, New York City*

How Garlock Ends Fire Hazard in Rubber Dust Duct

by Edward M. Dickinson
Plant Engineer
The Garlock Packing Company



Interior of Garlock plant shows exhaust system designed to reduce and control hazardous fires in ductwork.

High speed grinding of modern rubber compounds spews off fine rubber dust that poses fire hazard in duct of collection system. Garlock engineers have neat solution in novel dust collection system design.

RUBBER GRINDING has long been the source of nuisance fires in existing exhaust systems. Many types of dust collecting arrangements have been designed in an effort to reduce lost time accruing from these fires. All employ special devices to extinguish or contain fires and to facilitate the removal of burning rubber masses. A new exhaust system, designed by The Garlock Packing Company, has been successfully used for more than two years without a serious fire, and it has virtually eliminated downtime and labor loss due to ductwork fires.

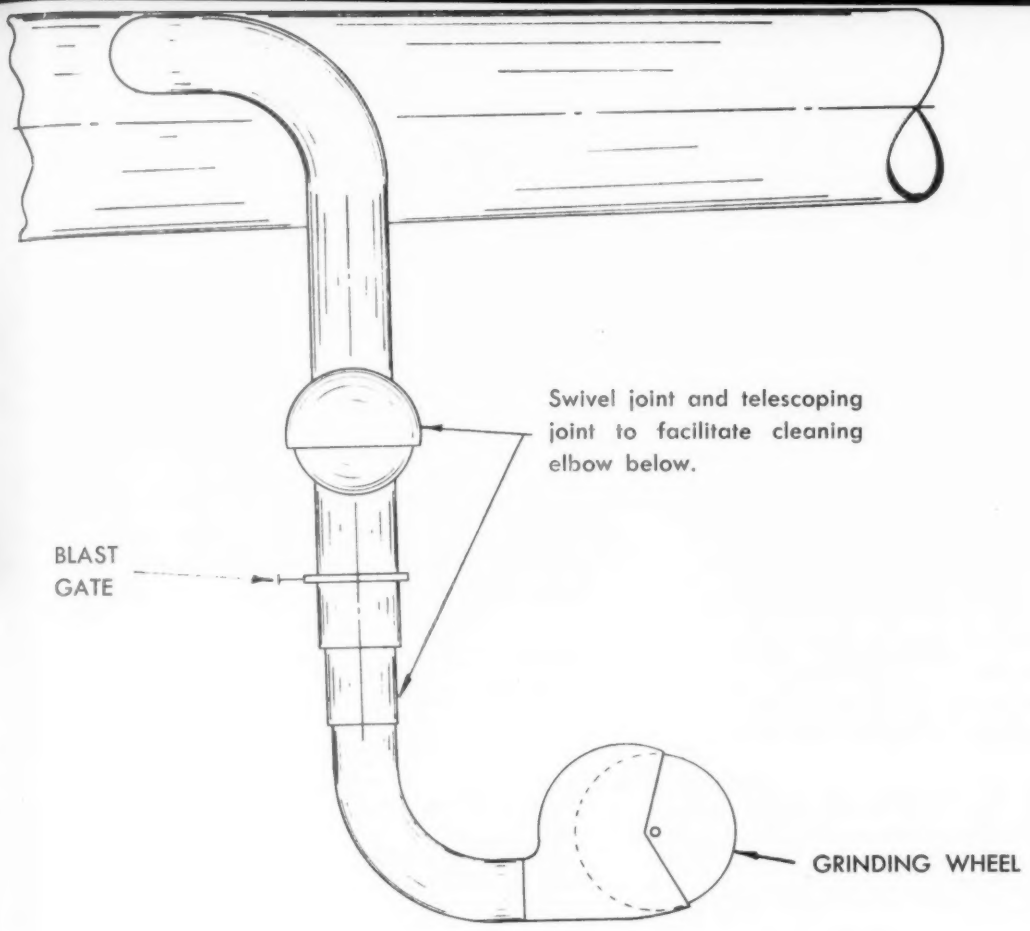
The new system represents a radical design departure from previous systems used on high speed rubber grinding. The principles employed in the new exhaust system do not *prevent* rubber fires. They do, however, reduce the *possibility* of burning occurring within the ductwork, and they simplify internal fire control.

The high speed grinding of modern rubber compounds presents a special problem to designers of dust collecting systems. Many of these compounds are known as "hot rubbers" because burning takes place almost immediately upon contact with the grinding wheels. The capture velocity of the air entering the grinding hood is necessarily high. The high velocity of the fine, soft and, often hot, rubber particles, tends to deposit build-up at critical points of air direction change. In conventional systems, elbows or the main duct surfaces opposite the branch entry points are usually areas of greatest build-up. When fires start at these points, it is necessary to halt production, extinguish the fire and remove the troublesome deposit. Many systems employ elaborate combinations of baffles or dampers to isolate the fire, then they flood the section with water spray, steam or carbon dioxide. These measures, while effective for the most part, usually present a second delay period to allow ductwork to thoroughly dry, preventing further build-up of dust on wet surfaces.

Cyclonic Air Action Induced

Garlock's solution to these problems is the use of a truncated cylinder as a main duct in which a cyclonic air action is induced. This design, coupled with special quick-disconnect sleeves at the first elbow past the grinding wheel hoods in the branches, has proven exceptionally efficient.

Cyclonic air movement is accomplished by introducing each of the branch pipes tangent to the top or bottom of the main duct. The branch pipes are arranged to enter horizontally and at a 30° angle to the axis of the main duct. The tangential arrangement of pipes and the acute angle of their entry in the direction of air flow, impells the air around the inner circumference of the main duct with a spiral action. The direction of air rotation is coincident with the fan blade rotation.



Elevation drawing at left shows arrangement of typical branch from exhaust system.

Continuous Cone Design

The efficiency of the system is dependent upon the continuous cone design of the main duct. Conventional exhaust design principles are based upon calculations to produce constant duct air velocities which preclude fallout or deposit of dust in low velocity areas. Basically, these principles state that the main duct is to be increased in area by an amount equal to each added branch, plus 20 percent. The increases are accomplished by a reducer transition of a calculated length dependent upon the main duct diameter. Because of the cylinder and reduction section construction. sudden changes in air velocities and direction sometimes are unavoidable. For instance, a system containing many branches will often employ the use of blast gates in branch pipes that can shut off branches to idle equipment. Closing blast gates causes a drop in air velocity in the main duct at the junction of the branch pipe. Abandoning or adding branches to main exhaust ducts may also seriously impair the efficiency of the system and create conditions which make duct fires unavoidable.

The efficacy of utilizing a continuously tapered cone, as in the Garlock-designed system, is that any branch may be added, relocated or removed without radically misproportioning the main duct, provided the added branch enters the main duct at the appropriate cross-section area. As in conventional systems, the tapered main duct system experiences changes in air velocity when branches are added, removed, capped or throttled by blast gates. However, velocity changes are constantly controlled by the uniform pitch of the main duct's taper. This is in contrast to the abrupt changes inherent in conventional systems which contribute to fallout.

Sweeping Air Action Keeps Duct Clean

The cyclonic air action also employs the air and conveyed particles in a sweeping action to keep the main duct clean. As in any exhaust system, long duct runs are avoided, and entering branches are spaced within three to five feet of each other. The exhaust fan is located as close to the end of the branches as is practical, and the cyclone and the enclosed dust bins are placed out-of-doors. Burning particles are conveyed out of the building where they are easily extinguished. The plant layout department works closely with the maintenance department when locating grinding equipment so that optimum efficiency

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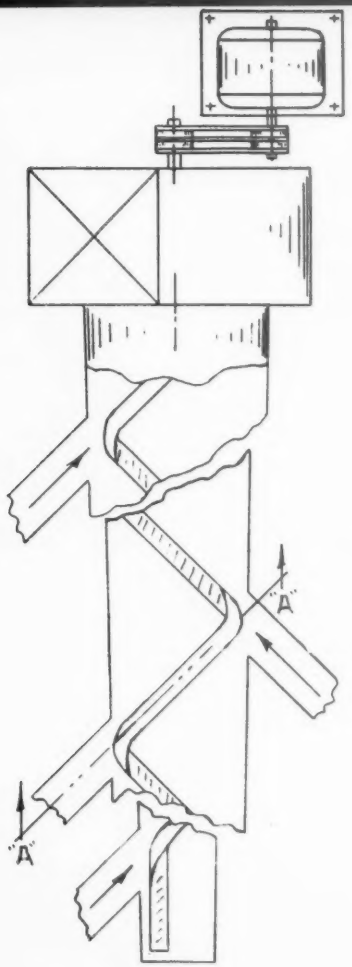
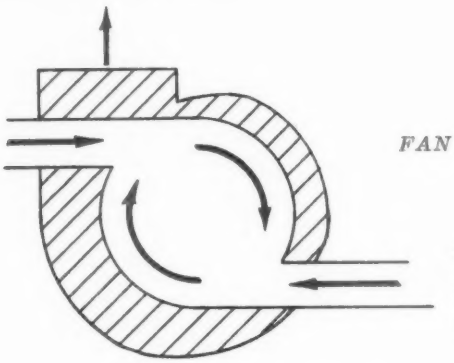


PLAN VIEW OF CYCLONIC AIR ACTION

Typical installation for 10 - 6" branches would be a 35" main trunk tapering from 8" to 21" at the fan with branches entering the main at approximately 3' intervals. Exact intervals depend upon calculated dust area.

Fan discharge to outdoor cyclone and collector.



Air and branch entry coincident with fan rotation.

SECTION A-A

(Continued from preceding page)

can be obtained from the exhaust system.

State labor departments and insurance companies insist that fire extinguishing devices be incorporated into dust collecting systems. Garlock installs an ordinary open sprinkler head in the small end of the main duct. The sprinkler head passes through an end cap fitted into the duct. This cap can be pulled back along the pipe for duct inspection. A second opening in the duct cap allows air to enter and keep the end of the main duct clean. Should a fire occur, the fan is left running to draw the water from the sprinkler head through the dust. This smothers and dislodges the burning mass quickly. The spiral action of the water droplets and the air keeps the fired particles separated and moving, thereby preventing agglomeration.

Conventional methods of calculating air duct velocities were used in designing the tapered main duct system. The top or the center line of the tapered main duct is horizontal, allowing water to flow toward the fan. The main duct is connected to the fan housing with a draw band to facilitate cleaning. ▲▲

Cold Air Influx Ended by Door Heaters

A FAMILIAR INDUSTRIAL PROBLEM, the influx of chilled air through open shipping doors, has been solved at American Furniture Company in Martinsville, Va., by installation of high-velocity door heaters.

The company's Plant 2 and Plant 5 face each other across a street, with heavy traffic between them. This means that the shipping doors in each plant must be opened frequently even in cold weather. The resulting cold air flow increased heating costs, threatened exposed raw materials, and adversely affected the efficiency of employees working near the doors. The problem was aggravated by dust collection system exhaust which creates a negative pressure inside each building. This slight vacuum adds to the velocity and volume of air admitted when shipping doors are open.

After a study of several possible solutions, American Furniture installed high-velocity door heaters made by the L. J. Wing Mfg. Co., Linden, N. J. A heater was installed above and just in front of each 8 x 8-ft. door, with its discharge 8½ ft. above the floor. A fan, blowing air down over steam-heated coils, enables each heater to produce a curtain of warm air downward to the floor. This tempers the incoming air, keeps raw materials safe, and keeps working areas near the doors at comfortable temperatures.

Coil tubing is aluminum-finned copper. Coils are individually replaceable, so that damage to a coil does not necessitate replacing an entire heating section. Steam is supplied at 6 to 12 psi.

At American, where contemporary furniture for living, dining and bedrooms is manufactured, the heaters are operated continuously in cold weather. Commonly, installations of this type are equipped so that a heater starts and stops automatically when a door opens and closes, or has thermostatic control to continue the heat after a door closes, until temperature in the door area has returned to normal. ▲▲

OIL . . . *A Leader In Air Pollution Control*

by Felix Chappellet, *Vice President and General Manager, Western Oil and Gas Association*

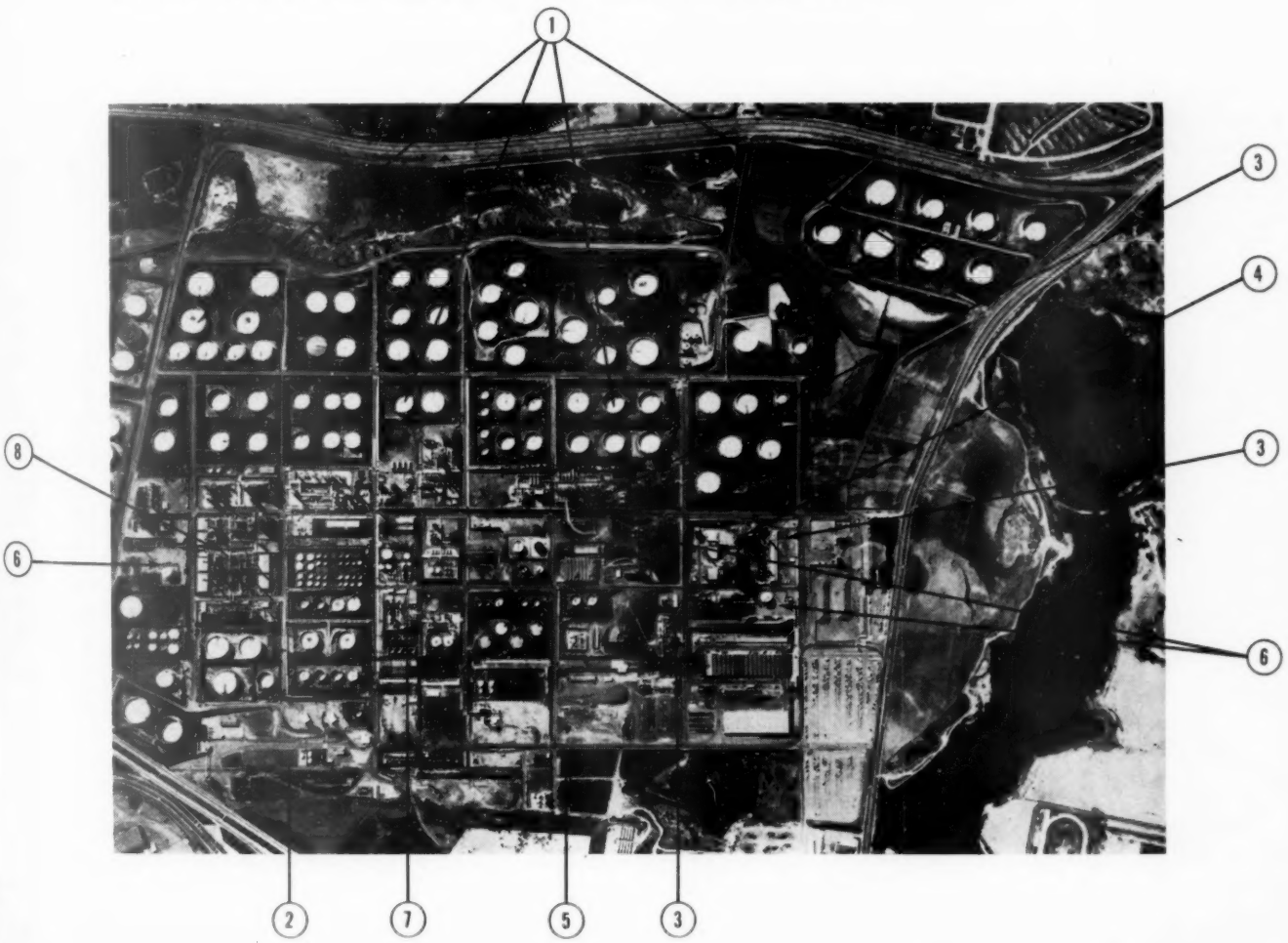
From well to refinery . . . from bulk storage to auto tanks . . . the petroleum people show what one industry can do about air pollution control when an all-out effort is made.

No other industry has been as aggressive as the petroleum industry in Los Angeles County during the past 12 years in waging war against air pollution. In a metropolitan area the size of Los Angeles, plagued with "smog" attacks that have attracted nation-wide attention, the oil industry has been a prime target for those who thought it the main culprit.

Since 1947, oil interests in the greater Los Angeles area have spent an estimated $44 million dollars in preventing impurities from escaping into the atmosphere. These stringent anti-pollution measures by the industry have cut off the daily escape of some 1700 tons of pollutants. In addition, $3,000,000 has been spent on air pollution research.

(Please turn to following page)

Fig. 1: *Below is shown a typical refinery where there are eight major areas of air pollution control as outlined in this article. Here are the major steps being taken and partial expenditures made to prevent pollution of the air over a major Los Angeles refinery: 1. Floating roof tanks, $3,750,000; 2. Truck-loading vapor recovery system, $185,000; 3. Sulfur dioxide abatement, $2,300,000; 4. Dust control, plume elimination, $425,000; 5. Oil-water separator vapor control, $375,000; 6. Waste gas recovery, smokeless flares, $650,000; 7. Plumbite stripper, $50,000; 8. Vacuum jet vent gas disposal, $75,000. Total: $7,810,000.*



Waste water emerging from refining units enters a sump that is roofed, permitting the capture and collection of petroleum vapors picked up by water in circulation.

Refinery personnel keep a constant check on sources of possible pollutant leakage. Here, an engineer points to valve on a "water seal" used in refineries to prevent air pollution. Water under pressure around the pump shaft is an effective seal against possible gas leaks.

This double-sealed floating roof type tank has floating roofs which rise and fall with the level of the liquid in the tank. This arrangement keeps the liquid from evaporating off into the open air.

(Continued from preceding page)

Topography and climate are the major factors in the formation of air pollutants in the Southern California area. The Los Angeles Basin is formed by a sweep of mountains on three sides, the Pacific Ocean on the fourth. The prevailing wind is from the ocean and it forces pollutants in a "trap" against the mountains. Simultaneously, a temperature inversion layer, common to the Los Angeles region, prevents the upward escape of these mountain-trapped pollutants.

Los Angeles atmospheric pollution differs from air pollution in other major cities. It is comparatively low in smoke and dust content but it does contain two air pollutants, organic hydrocarbons and oxides of nitrogen. Both of these are emitted by refineries, altho the emissions are a small percentage of the total.

Problem Started In 1947

In 1947, with the influx of new industry going in alongside plants already established during World War II, air pollution became a serious problem in Los Angeles.

The cause of the pollution at that time was unknown, but the oil industry launched a positive program to determine what caused smog and to put an end to it. Vigorous actions were also taken to prevent refinery pollutant emissions even before the industry was suspected of contributing to air pollution.

Initially, action was taken to reduce sulfur dioxide emissions from refineries. At that stage of research these sulfur dioxide gases were thought to be the major contributor to smog. Work on SO_2 reduction resulted in the elimination of 650 tons of pollutants a day.

Sources of Pollution

The Los Angeles County Air Pollution Control District, the enforcing agency in Los Angeles County, has now broken down the sources of pollutants into these major categories:

1. *Hydrocarbons:* Approximately 1400 tons are thrown off daily into the atmosphere, of which 1000 tons come from motor vehicle exhausts, about 200 tons are emitted by industrial and commercial sources other than those operated by the oil industry, 100 tons from other sources, and 100 tons from refinery operations.

2. *Oxides of nitrogen:* Some 700 tons are discharged daily, including 430 tons from motor vehicles, an estimated 215 tons are produced by industrial and commercial sources and approximately 55 tons from the petroleum industry.

To cut down on the discharge of hydrocarbons into the atmosphere, the industry, in cooperation with the APCD took a number of measures to reduce these emissions.

Among these were:

1 Installation of floating roof tanks and vapor recovery systems.
2 Covered waste water separators.
3 Installation of mechanical seals on pumps.
4 The institution of a program to eliminate losses during loading of tank trucks.

Principles behind the industry's anti-pollutant devices are these:

The construction of the floating roof tanks allows the roof of the tank to rise and fall with the level of liquid in the tank. There is no emission of petroleum vapors when the tank is filled or when the liquid level drops.

In the vapor recovery system, large pipelines lead from exhaling rigid-type containers to a central vessel where the vapors can be drawn and collected. Repressuring lines carry dry gas back to inhaling containers as their liquid level drops. The recovery system requires the use of a compressor, absorption tower, cooling equipment, heating units, pumps, instruments and vessels — thousands of dollars worth of equipment.

Covered waste water separators prevent emission of pollutants from these units while the installation of special pump packings and water seals have been engineered into refining equipment to prevent the smallest leaks.

Vapor Loss Elimination

Vapor losses have been eliminated during the loading of tank trucks by collecting the vapor in a special "loading arm." The vapor is pumped out of the tank during the loading process and returned to compressors where it is "reconverted" into gasoline.

Incinerators have been installed at refineries to burn odorous gases and oil droplets out of the relatively small waste vented to the atmosphere. Fuels and equipment are under constant inspection, by men and instruments, to guard against the emissions due to malfunctions or accidents.

Sulfur compounds in varying amounts are found in practically all crude oils. During the refining process some are converted to hydrogen sulfide. The substance burns quite readily and is satisfactory as a refinery fuel. Los Angeles air pollution authorities, however, objected to the stack gases resulting from its combustion. As a result, fuel gas containing sulfur compounds is treated in facilities which absorb the odorous gas and then convert it to elemental sulfur which is sold to Los Angeles chemical plants.

Installation of such sulfur refining units, at a typical Los Angeles refinery, cost $2,300,000. The sulfur pays for only a fraction of the cost of plant maintenance and operation. But hydrogen sulfide disposal through burning is no longer a nuisance.

In the manufacture of gasoline by fluid catalytic cracking units, catalyst dust fines, resulting from re-

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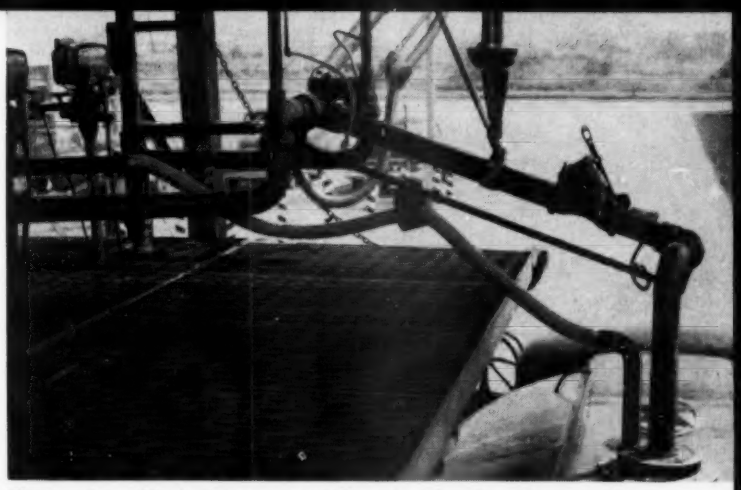
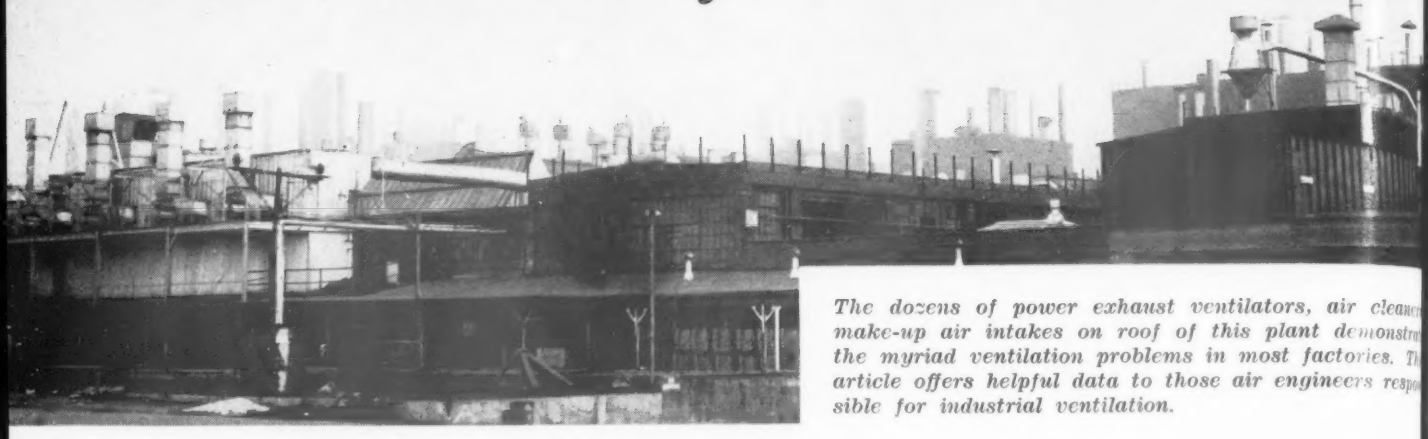


Vapor is collected from gasoline trucks by the special loading arm shown above. The vapor is pumped through the flexible hose passing through the vapor-proof plug on the truck (at right) into the vapor compressor system.

Refineries are models of exceptionally clean coking. For example, the downward curving pipe (above), instead of venting pollutants to the atmosphere, carries them to a pair of sulfur plants. The plant operation "scrubs" the waste material and pays for part of the operation by recovering small quantities of sulfur which is then sold commercially.

This "blowdown stack" releases only a trace of exhaust from the huge refining unit it serves. Even this small volume of waste gas is "flared" at the outlet to prevent smog. Refinery personnel are constantly on the alert to guard against pollutants escaping into the atmosphere.

PRIMER *on Factory Ventilation* PART II



The dozens of power exhaust ventilators, air cleaner make-up air intakes on roof of this plant demonstrate the myriad ventilation problems in most factories. This article offers helpful data to those air engineers responsible for industrial ventilation.

Now is the time to get ready for the heating season. Here is helpful data on which of the three basic make-up air systems to use, factors influencing sizing of make-up air units, types of equipment, temperature controls, filtering, air distribution, system numbering and cost factors involved.

IN PART II OF THIS MONTH'S PRIMER on factory ventilation we take up advantages and disadvantages of gas as fuel for make-up air units, and discuss the various types of make-up air equipment, their features and applications. The author's experience with line or direct-fired type burners for make-up air use is outlined, along with an interesting episode involving use of these burners.

Natural gas as a fuel for heating supply or make-up air is becoming increasingly popular. This is especially true of older plants where existing boiler capacity has been exceeded and any additional heaters would require simultaneous expansion of boiler facilities. Gas as a fuel has the following advantages:

1. No piplines and equipment to freeze.
2. Gas is a clean burning fuel.
3. Gas requires no return facilities and supply main layouts are very flexible.
4. Maintenance operations need not be extended beyond the heating unit itself.

Against these advantages the following disadvantages must be weighed:

1. Gas mains and equipment present a potential hazard and as such require more frequent check and closer supervision.
2. There exists the possibility of interrupted supply often resulting in a necessity for standby equipment.
3. Cost of gas varies considerably with different localities but will seldom be lower than coal in actual cost per Btu.
4. Gas fired equipment cannot be used in atmospheres where an accumulation of explosive gases or vapors may occur.
5. Turn down limitation.

Gas heating equipment can be classified as combustion chamber type (Fig. 5), line burner or direct fired (Fig. 6), and radiant type. Since the radiant type is not used to heat air but performs its function in actually heating objects directly by radiation, it has no application in make-up air and will, therefore, not be discussed further.

The combustion chamber type heater is often referred to as "direct fired." This reference, however, is now obsolete and incorrect since gas heaters that heat by actual direct contact with the air are becoming increasingly popular for heating make-up air. This point is not to promote either type of heat exchange but rather to prevent confusion.

The combustion chamber type gas heater has very positive advantages:

1. This type of heater (Fig. 7) can be used to recirculate a portion or all of the air if desired. This feature will permit installation of heaters of adequate capacity for all but severest conditions. When these

Fig. 5: *Below, a typical combustion chamber type gas-fired make-up air heater is shown.*

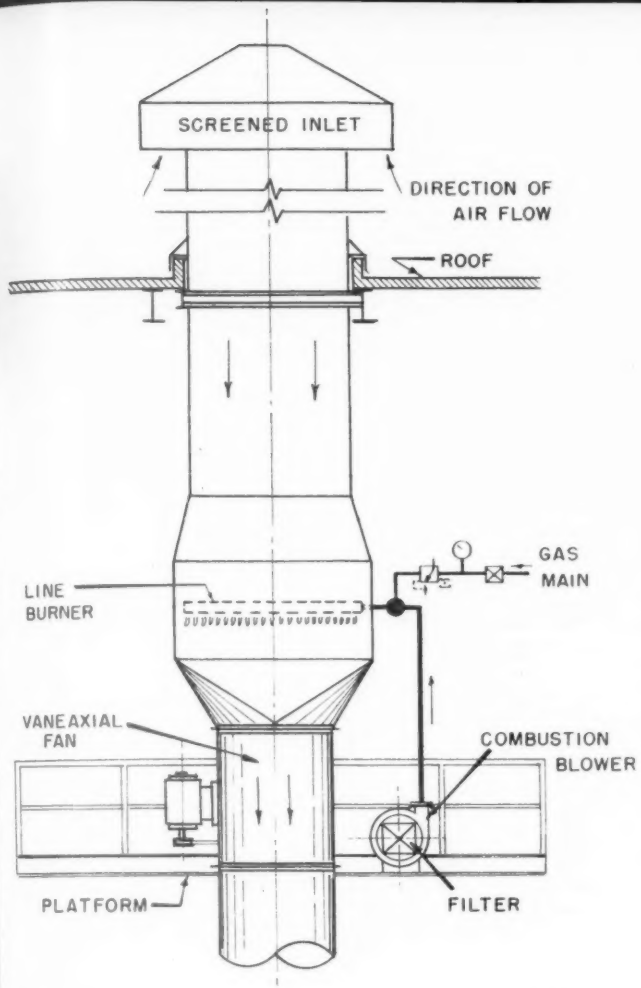


Fig. 6: *Line burner or direct-fired make-up air heater is shown above. Be sure these units are approved by Factory Insurance Association before purchase.*

severe or abnormal temperatures do occur a percentage of air can be recirculated to assure adequate discharge temperatures.

2. Where possibility of interrupted gas supply exists this equipment can be equipped with combination oil-gas burner.

3. Since products of combustion are not delivered to the work area, temporary maladjustment is less serious.

The "direct fired" or line burner type of heater has its greatest application in the heating of make-up air. This principle of heating air being supplied to occupied areas is comparatively new, and prior to actual purchase of any such equipment, the Factory Insurance Association* should be contacted for comment and clearance. F.I.A. apparently sees no objection to this equipment provided proper safety devices are included. Safety requirements are the same as ovens or similar heaters using gas as a fuel.

*Factory Insurance Association has three regional and 21 branch offices throughout the country. If no FIA office is listed in your phone directory, write: L. B. Hansen, Sup't., Engineering and Inspection, Factory Insurance Association, 85 Woodland St., Hartford 2, Conn.

TABLE 1

NO.	GAS	CO_2 IN CU. FT.
1.	NATURAL GAS (BIRMINGHAM)	1.00
2.	NATURAL GAS (PITTSBURG)	1.15
3.	NATURAL GAS (SO. CALIFORNIA)	1.14
4.	NATURAL GAS (LOS ANGELES)	1.16
5.	NATURAL GAS (KANSAS CITY)	0.98

The first two such direct fired installations at one plant (Fig. 8) were completed and initial firing and adjustments were made over a weekend. The first unit supplied an area adjacent to a machine shop where heavy machining schedules were being carried on at the time of the initial start-up.

The plant Safety Department was called in to run carbon monoxide checks. These tests revealed only a trace of CO, not sufficient to cause any discomfort even after long exposure. As a result the units were allowed to remain in operation under surveillance for the weekend.

Monday morning, maintenance personnel observed a heavy fog or deposit on maintenance department office windows. First impulse was to condemn the new heaters, but subsequent examination of samples scraped from the windows indicated that the deposit was a combination of dust and cutting oils from the surrounding machining operations.

This plant now has complete confidence in this type of make-up air heater, having a total of 15 in operation with two more in the project stage.

It is important, however, to use these units to supply make-up air only. Air should never be recirculated through these heaters since products of combustion would build up with each pass. Used strictly for make-up air purposes, and carefully adjusted, it is possible to have practically no carbon monoxide in the discharge. Actual tests have been made with extremely sensitive methods (capable of measuring down to .0002 percent), showing none present. The

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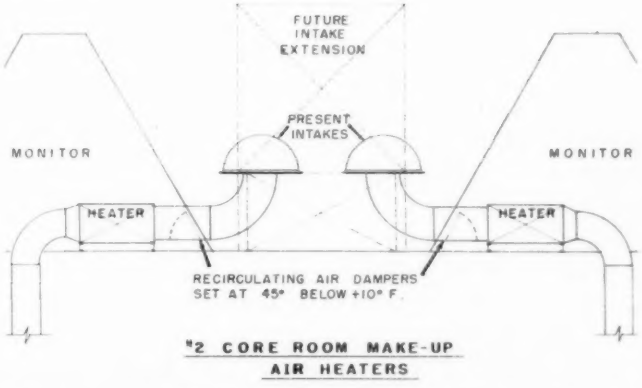


Fig. 7: *Combustion chamber type heaters here can be used to recirculate part or all of heated air.*

Fig. 8: *This direct-fired heater unit supplies an area adjacent to a machine shop.*

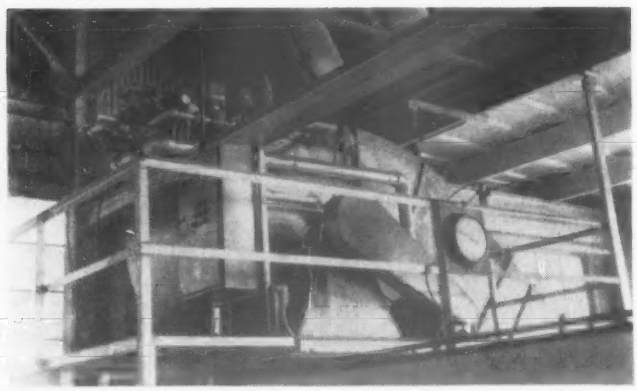


Fig. 9: *This direct-fired unit remained in operation over a very cold week-end, causing moisture to collect and freeze on dust collector walls, hoppers and conveyor parts, delaying production on the following Monday. Venting of excess air through the collector caused the trouble.*

(Continued from preceding page)

allowable maximum concentration (MAC) for CO is 100 ppm.

Carbon dioxide is also a product of combustion which cannot be ignored. MAC is 5,000 ppm. So if the air being brought in over the line burner will dilute the CO_2 content down to 0.5 percent or less the heater should be safe. Actual content as a product of combustion can be determined from the Table I. At maximum output and providing an 80 F rise CO_2 will be less than 0.17 percent or about one third of the MAC.

Oxides of nitrogen are also formed in small quantities, but here too, if fresh outdoor air is used, dilution will reduce MAC well below acceptable limits.

Moisture is also a product of combustion when burning gas. Normally this is not objectionable; however, under some circumstances it can be a nuisance. For example, we know of an instance where a direct fired unit (Fig. 9), inadvertently remained in operation over a very cold weekend. Result was that the building was pressurized and excess air was vented out through a cloth screen duct collector on the roof of the building. Moisture in the air condensed on the cold sheet metal walls of the collector and froze in the hoppers and conveyor underneath, causing delay in getting the equipment in operation on Monday morning.

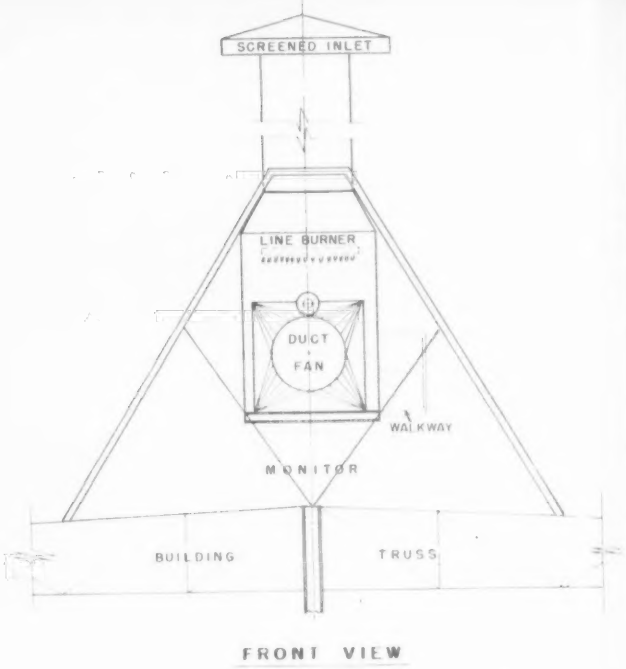


Fig. 10: *Direct-fired make-up air heater arrangement.*

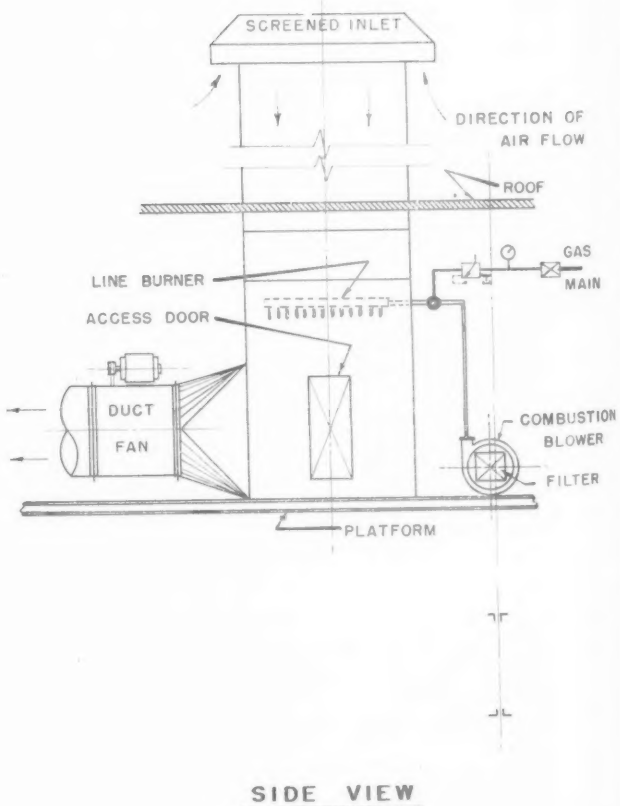


Fig. 11: *Direct-fired make-up air heater arrangement above shows one of many possibilities of this unit.*

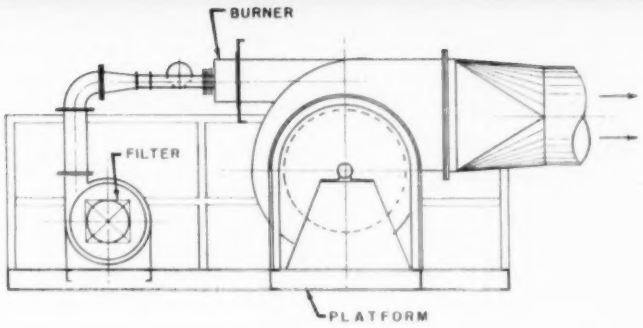


Fig. 12: *Right, this direct-fired unit arrangement again illustrates installation versatility.*

There are two items which have made the line burner make-up air heater very attractive.

1. Since combustion takes place directly in the air stream, all heat given up is delivered with the air to the work area. A combustion chamber type heater of 2,000,000 btu capacity will discharge as many as 400,000 cu. ft. of make-up air per minute; six million btu would be discharged to the atmosphere every hour when the heaters are operating near capacity.
2. The direct-fired unit offers a variety of arrangements as shown in Figs. 10, 11, 12, 13 and 14.

The following items should be incorporated in a line burner type heater installation:

1. Safety equipment as required by the covering insurance and the completed installation must meet insurance approval. The latter requirement should appear in the specifications.
2. The combustion air should be filtered to reduce cleaning time on the line burner as well as control valves.
3. All controls should be mounted in a central control panel and free from vibration.
4. Sight glasses or ports should be provided so pilot and burner can be viewed from the control panel.
5. Sight glasses should be provided so the burner can be viewed while making adjustments on the control valves.
6. Access doors should be provided so the entire burner is accessible for cleaning.
7. Pilot and flame rod should also be readily accessible.

Next month . . . methods of filtering make-up air, temperature control systems and techniques of air distribution in factories will conclude this three-part series on industrial ventilation. ▲▲

DIRECT FIRED COMBINATION FAN & BURNER

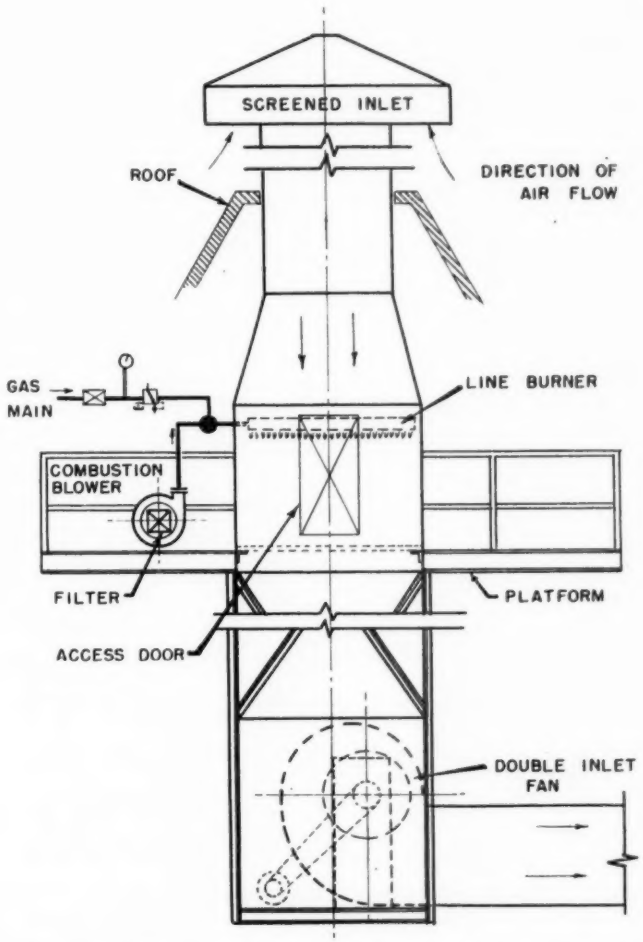


Fig. 13: *Here fan is beneath the unit, as compared with Figures 10, 11, 12 and 14.*

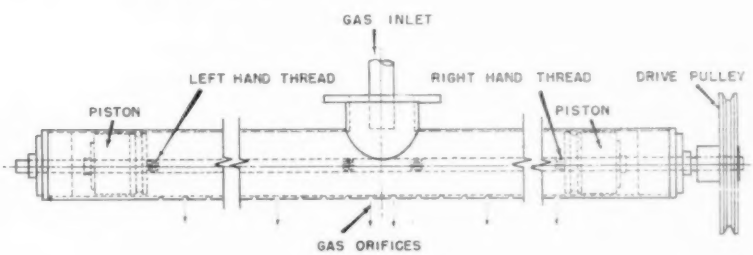
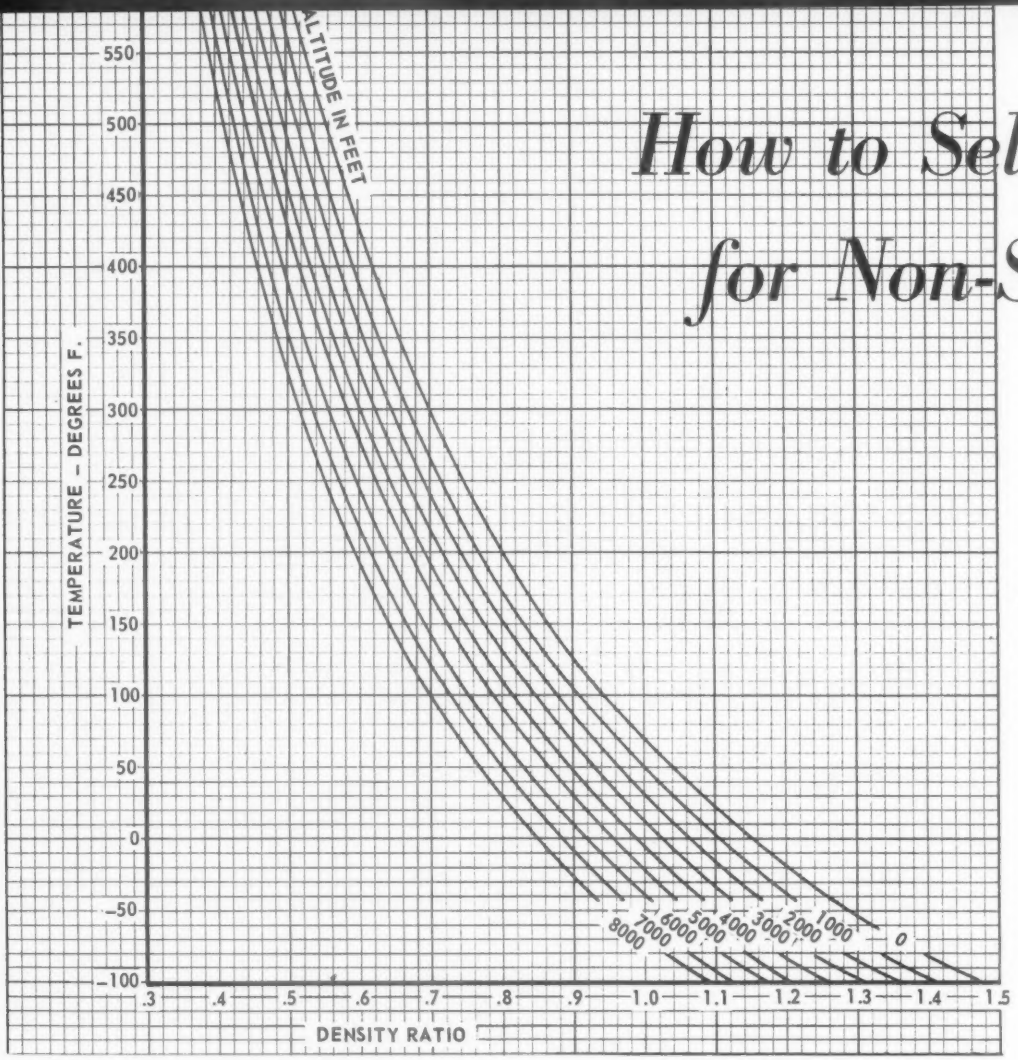


Fig. 14: *Still another arrangement of the direct-fired make-up air heater.*

DIRECT GAS FIRED MAKE-UP AIR HEATER



How to Select Fans for Non-Standard Air

by H. K. Monroe
Chief Engineer
Aerovent Fan Co., Inc.
Piqua, Ohio

Fig. 1: *Density Ratio Chart. Engineering Bulletin 113-1 Copyright 1959 by Aerovent Fan Co., Inc.*

Here's a quick way to make fool-proof selection of fans that are to operate under high altitude conditions, low temperature or any combination of density and temperature.

THE STANDARD TEST CODES for all fan equipment, including propeller and axial units, call for performance ratings to be calculated to standard conditions and tabulated for a given air density. Standard air density is .075 pounds per cubic foot, which corresponds to the weight of one cubic foot of dry air at 70 F and at sea level, which is a barometric pressure of 29.92 in. of mercury. The most important factors which might change the weight of air are temperature and altitude. Water vapor is also a contributing factor; however, the change caused by an increase or decrease of moisture content is relatively small and is seldom considered in the practical application of fan equipment.

In the normal ranges of summer and winter temperatures and at altitudes up to 1000 or 1500 ft., the change in air density is not of sufficient importance to make any correction. These are the usual operating circumstances for ordinary ventilating installations and fan ratings selected from individual catalog charts may be used directly. In fact, for ordinary ventilating installations, it is quite unusual for correction to be made in the fan equipment for any altitude or normal atmospheric temperatures. Frequently, we encounter situations involving fans in systems at air temperatures considerably higher or lower than normal and installations where heat exchangers are involved. *For these it is important to make corrections for both altitude and temperature.*

As has already been pointed out, fan rating tables are based on air weighing .075 pounds per cubic foot. We can, therefore, determine the difference between the weight of standard air and the weight of air at any other density in terms of a ratio. We use this ratio, normally referred to as the "Density Ratio" for calculating the fan performance required. To deter-

Cat. No.	Fan Size	Fan RPM	Motor HP	Free Delivery		C.F.M. and Horsepower Against Resistance															
						⅛"		¼"		⅜"		½"		¾"		1"		1¼"		1½"	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
7-321	32	870	½	7320	.265	6500	.317	5550	.365	4150	.400	2300	.370	450	.317						
7-322	32	870	¾	9450	.390	8725	.465	7750	.545	6550	.610	4500	.590	1200	.600						
7-324	32	1160	1	9750	.650	9150	.715	8500	.780	7750	.845	6900	.900	4400	.925	2300	.850	1050	.790		
7-325	32	1160	1½	12600	.900	12100	1.00	11500	1.10	10800	1.20	10060	1.30	8000	1.47	4200	1.35	2250	1.39	400	1.50
7-327	32	1750	3	14800	2.25	14300	2.35	13900	2.47	13500	2.59	13100	2.68	12250	2.89	11250	3.05	10150	3.20	8800	3.30
7-328	32	1750	5	19100	3.17	18900	3.27	18400	3.47	17900	3.67	17500	3.82	16500	4.20	15500	4.55	14500	4.80	13500	4.97

Fig. 2: *Sample Fan Rating Table*

mine this factor easily, we have prepared a "Density Ratio Chart" identified as Engineering Bulletin EB 113-1 (Fig. 1). This is a plotting of temperature against density ratio with lines of altitude at 0 ft. to 8000 ft.

For purposes of demonstration, let us consider a typical problem: We will assume that a 32-in. belt driven duct fan delivering 10,000 cfm against 1 in. static pressure at 200 F, and at sea level is required. We would first determine the density ratio from the density ratio chart. Reading across from 200 F to the line 0 ft. altitude, we find that the point of intersection indicates a density ratio of .80. We divide the required static pressure by the density ratio before reading into the fan rating tables. This is 1 in. divided by .80 equals 1¼ in. We would therefore select a fan rated at 10,000 cfm at 1¼ in. from the table. As indicated in the sample rating table (Fig. 2) the fan which comes closest is the semi-pressure fan No. 7-327 which is listed at 10,150 cfm at 1¼ in. using a 3 hp, 1750 rpm motor.

It should be noted that the rating selected is on the conservative side rather than one which would be rated under the actual requirement. Brake horsepower listed for this unit in the table is 3.2. Since, in this application we are handling hot air which is lighter, the horsepower required will be somewhat lower. The actual operating horsepower would be $3.2 \times .80 = 2.56$ bhp. As our fan temperature chart (Fig. 3) shows us, a belt driven duct fan should always be kept running when the temperature is above 180 F. This fan has an air-insulated drive housing. The belts and bearings are kept cool by the action of the fan itself. The fan will operate without any other provision for cooling of bearings at temperatures up to 600 F.

TYPICAL TEMPERATURE RANGE GUIDE

FAN	MAXIMUM AIR STREAM TEMPERATURE IN DEGREES F.	
	STANDARD	SPECIAL
BELT-DRIVEN DUCT	275°	600° — SEE 1
EXTENDED SHAFT	275°	350° — SEE 4 850° — SEE 2
"BI-FLO" DUCT	275°	400° — SEE 5
VANEAXIAL	250°	
PULLEY DRIVE	180°	
DIRECT-DRIVEN DUCT	CLASS A MOTOR — 104° MAX. SEE 3	
	CLASS B MOTOR — 140° MAX. SEE 3	
DIRECT-DRIVEN RING	CLASS H MOTOR — 212° MAX. SEE 3	

1. With bronze propeller, high temperature lubrication and thermal switch to keep fan running when temperature is 180° or higher.
2. Water cooled (automatic water control recommended), bronze propeller and high temperature lubrication.
3. With breather pipe add 60° and use thermal switch set for "on" at maximum temperature for motor used. (Note: Do not use low-speed fans where maximum temperature operation is required.)
4. With bronze propeller and high temperature lubrication.
5. With bronze propeller.

Fig. 3: *Fan Temperature Chart*

Another requirement may be stated differently. For example, the specification might read: "Belt Driven Duct Fan 36 in. diameter, capacity 10,000 cfm at ¾ in. static pressure, standard air conditions, performance to be *equivalent* at 430 F and 5000 ft. altitude." This would present a slightly different situation. In this case the requirement is that the same *weight* of air be handled at the non-standard conditions. Thus, it becomes necessary to determine what volume of air at 430 F and 5000 ft. altitude would weigh the same as 10,000 cfm at standard conditions.

To arrive at this figure we would divide the cfm by the density ratio; (from the chart 430 F at 5000 ft.

(Please turn to page 51)

Cat. No.	Fan Size	Fan RPM	Motor HP	Free Delivery		C.F.M. and Horsepower Against Resistance															
						⅛"		¼"		⅜"		½"		¾"		1"		1¼"		1½"	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
7-368	36	1160	1	9500	.600	8800	.710	8050	.800	7250	.870	6300	.910	3900	.935	2500	.880	1390	.800		
7-370	36	1160	2	16000	1.38	15050	1.52	14100	1.65	13150	1.78	12100	1.90	9250	2.02	5600	2.05	3250	2.02	1700	2.00
7-371	36	1160	3	18250	1.90	17450	2.00	16650	2.15	15900	2.28	15050	2.40	13050	2.60	8700	2.57	5500	2.59	4250	2.64
7-372	36	1750	3	14400	2.30	14000	2.40	13400	2.57	12900	2.70	12300	2.80	11300	3.00	10300	3.10	9100	3.20	7600	3.30
7-373	36	1750	5	20800	3.65	20500	3.75	20100	3.95	19700	4.20	19300	4.40	18400	4.80	17300	5.25	16200	5.61	14950	5.90
7-374	36	1750	7½	25200	5.30	24900	5.45	24350	5.77	23800	6.00	23350	6.23	22300	6.75	21150	7.10	19800	7.45	18500	7.65
7-375	36	1750	10	28700	6.50	28100	7.05	27500	7.17	27000	7.30	26300	7.42	25000	7.75	23200	8.30	21800	8.71	20500	9.05

Fig. 4: *Sample Fan Rating Table*

CASE HISTORY . . .

Precipitator Cuts Fly Ash from Power Plant

by C. L. Gallaer
Assistant Chief Engineer
Buell Engineering Co.

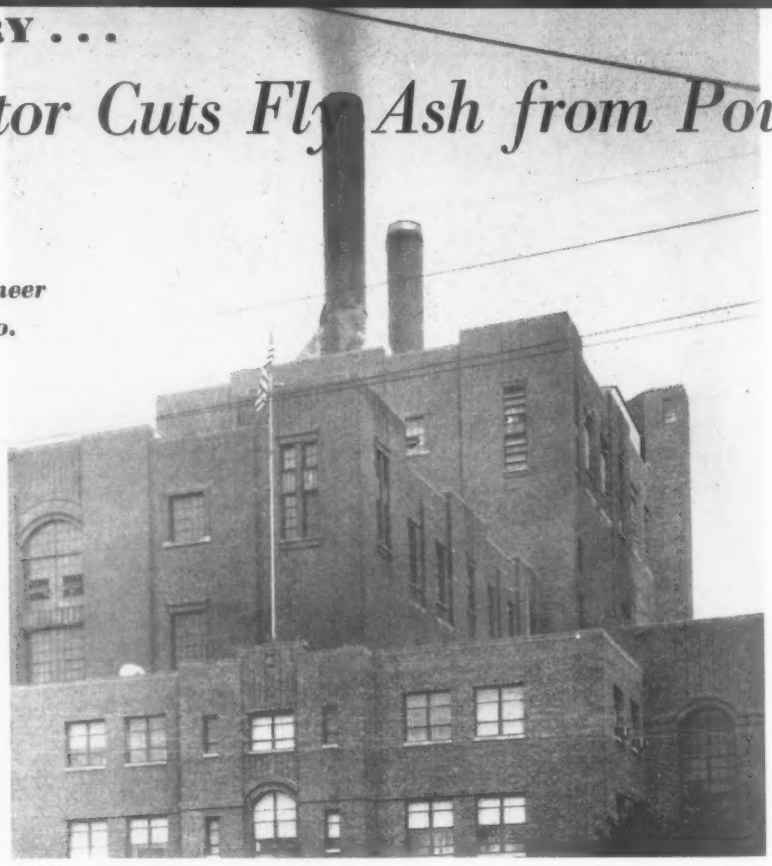


Fig. 1: *Effectiveness of electrostatic precipitator is demonstrated in the stack at right as compared with mechanical collector on old boiler.*

Almost invisible emission . . . reduced draft-fan maintenance . . . greater combustion efficiency are benefits Pennsylvania Power Co. obtained from this electrostatic precipitator installation on a new 690,000 lb/hr boiler.

UTILIZATION OF AN ELECTROSTATIC PRECIPITATOR for the collection of fly ash from its new 690,000-lbs-of-steam-per-hr boiler, has helped the Pennsylvania Power Co., New Castle, Pa. to obtain greater steam output from this boiler than from a similar boiler utilizing a cyclone collector. The precipitator contributes to this improvement by decreasing resistance to air flow through the system and increased combustion rate made possible by the lower resistance of the electrostatic collector.

A further important advantage gained by use of the electrostatic precipitator is the much greater efficiency with which it removes fly ash from the combustion gases. In Fig. 1, a perceptible emission of smoke is visible from the stack serving a similar boiler at left, but the visible output from the new boiler at right is so negligible that one's first inclination is to assume the boiler is not in operation.

By removing a higher percentage of fly ash from the combustion gases, the electrostatic precipitator is expected to reduce draft-fan maintenance requirements, which are normally extensive where a mechanical collector is used.

The Buell collector is housed in an asbestos-board enclosure on the roof of the power plant as shown in Fig. 2. Combustion gases enter the precipitator from the air heater. Fly ash is collected in the precipitator hoppers (Fig. 3), and cleaned gases exhaust through the stack to atmosphere. Fly ash is pneumatically withdrawn from the hoppers, mixed with water, and flows by gravity to a fill area.

The precipitator is constructed in two sections, each enclosing 28 rows of vertical metal plates arranged parallel to the gas flow, and some 1400 vertical wires interspaced among the plates (Fig. 4). The wires, or emitting electrodes, are charged with a high negative d.c. voltage, while the plates, or collecting electrodes, are grounded.

How Precipitator Operates

As a dust particle travels through the precipitator, it receives a negative charge from an emitting electrode and is attracted to a collecting electrode from which it falls into the hopper below. In practice, deposits of fly ash build up on the collecting electrodes and rapping mechanisms are provided to dislodge the fly ash into the collecting hoppers. The panels are rapped individually one after another, so that each is rapped approximately once every three minutes. A certain amount of fly ash also collects

on the emitting electrodes and the frames on which these are secured are rapped once each minute to dislodge the accumulation.

Each of the two precipitator sections is served by an individual power pack, a power pack consisting of a transformer-rectifier and control cabinet (Fig. 6). The transformer-rectifiers step up plant a-c voltage and convert it to d-c for application to the emitting electrodes.

A maximum of 66,000 volts may be applied to the emitting electrodes but they are normally operated with a somewhat lesser charge. The emitting electrodes are suspended from supporting insulators which are individually housed and provided with thermostatically controlled heaters. The heaters prevent formation of condensation during shut down and avoid the subsequent possibility of shorts when starting up.

Removing Fly Ash

Power is supplied to the transformer-rectifiers through respective control cabinets (Fig. 6). Each cabinet contains on-off controls for rectifier motor, rapping motors and heaters, as well as indicators for transformer primary current, precipitator voltage, precipitator current and filament voltage of the main rectifier tube. A voltage hand-wheel control and main power switch also are provided.

The removal of fly ash is controlled from a panel located between the two dust collector panels. The key element of the fly ash removal system is a vertical Venturi throat ringed internally with downward directed water nozzles. The Venturi is located several landings below the collector hoppers and a 6 in. pipe extends from the hoppers into the Venturi throat. The force of the water pumped through the nozzles around the throat creates a vacuum and this is used to withdraw the fly ash from the hoppers and into the vacuum line connecting to the Venturi. Water and fly ash discharge from the Venturi into an air separator tank on the floor below and flow by gravity to the fill area (Fig. 7).

The hoppers are arranged in two parallel rows of four each and each row is served by a branch pipe which connects with the main line to the Venturi.

In addition to individual valves at each hopper output, each of the two branch lines has a valve where it meets the main line. The system is engineered so that hoppers will automatically empty in sequence, one valve closing and the next one open-

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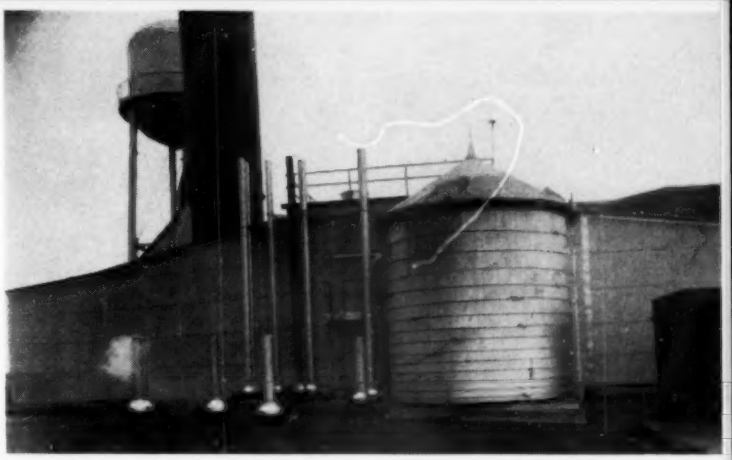


Fig. 2: ***High efficiency collector on power plant roof is housed in asbestos enclosure behind the house water tank.***

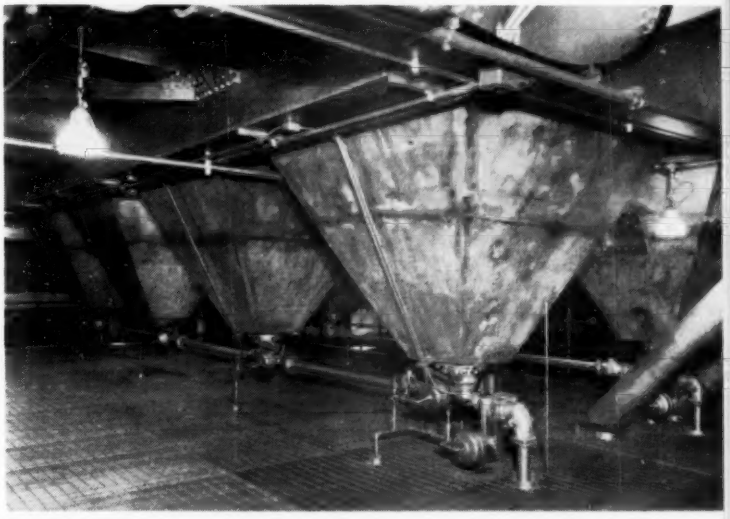


Fig. 3: ***Fly ash is collected in eight hoppers beneath the precipitator and withdrawn through remotely controlled hopper outlet valves. Valves can be automatically operated to empty hoppers in sequence or can be manually operated. Vacuum withdraws fly ash from hoppers.***

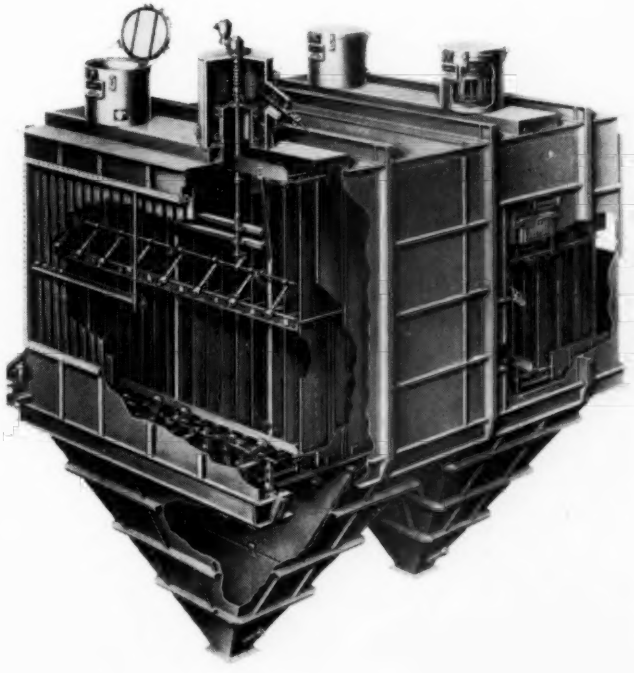


Fig. 4: ***Cutaway of Buell electric precipitator. Combustion gases enter from left through vertical baffles which help distribute them evenly among the collecting electrodes. Rapping arrangements for both collecting and emitting electrodes are shown, as are high voltage terminals for the emitting electrodes. Fly ash is collected in hoppers and cleaned gas continues through to stack.***

Fig. 5: *Top of precipitator showing enclosures housing suspension equipment for emitting electrodes. Furthest enclosure contains emitting-rapper motor. Note grounding poles at each high-voltage hatch.*

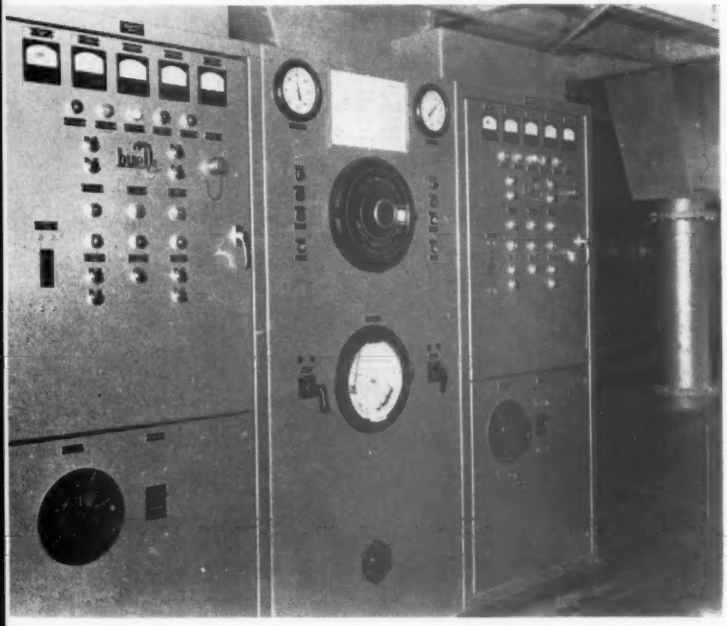


Fig. 6: *(Above) Control panels for both sections of the electrostatic precipitator and for the fly ash removal system. Although both sections of the precipitator are normally in operation, they may be operated independently if desired.*

(Continued from preceding page)

ing as each hopper empties. As a hopper empties, a partial opening is formed between the main body of the collector and the vacuum line and the vacuum at the outlet valve decreases. When the vacuum falls below a certain value, the valve automatically closes and the next in line opens. The emptying operation can also be manually controlled and hoppers can be emptied in whatever order is desired.

The control panel contains a water pressure gauge indicating pressure of the water which is pumped to the Venturi nozzles, an air gauge which indicates the vacuum at the hopper valves, start-stop buttons which operate the system, and indicating lights that show whether or not it is in operation.

Started With 350,000 lb/hr. Boiler

The New Castle power plant was first started up in 1939 with a 350,000-lbs-of-steam-per-hr boiler. In 1947 a 450,000-lbs-of-steam-per-hr unit was added and in 1952 capacity was increased another 690,000 lbs of steam per hr. The new unit, placed in operation late last year, also has an output of 690,000 lbs of steam per hour. This plant serves all of Pennsylvania's Mercer and Lawrence counties and parts of Beaver, Butler and Allegheny counties.

Rating of the new turbo generator is 95 MW while the rating of the 1952 installation is 90 MW. The increased capacity is due to greater air flow which was accomplished by proper sizing of the induced draft fan in relation to the resistance. An electrostatic collector offers less resistance to air flow and thus contributes to the increase obtained with the larger fan. ▲▲

Fig. 7: *(Below) Fill area into which fly-ash slurry is piped. Area to right has been largely filled in. Small piles are earth that will be spread around to prevent ash from blowing away during dryer summer months.*

? ? ? ? ? ? ? ? Questions & ANSWERS ? ? ? ? ? ? ? ?

Question:

We have a problem in air pollution control with which you might be able to help us. We have to measure the air velocity in a wet scrubber tower. The velocity is within the range of 150 to 300 fpm, and the air current carries minute droplets of water.

The range is too low for using our Pitot Tube (600-10,000 fpm). The droplets of water make it impossible to use our electrical resistance velocity meter.

A vane type anemometer if it is sensitive enough to cover the range will not operate properly in the presence of dust and droplets of water.

Do you have a technique or an instrument to suggest?

C.A.R., Ore.

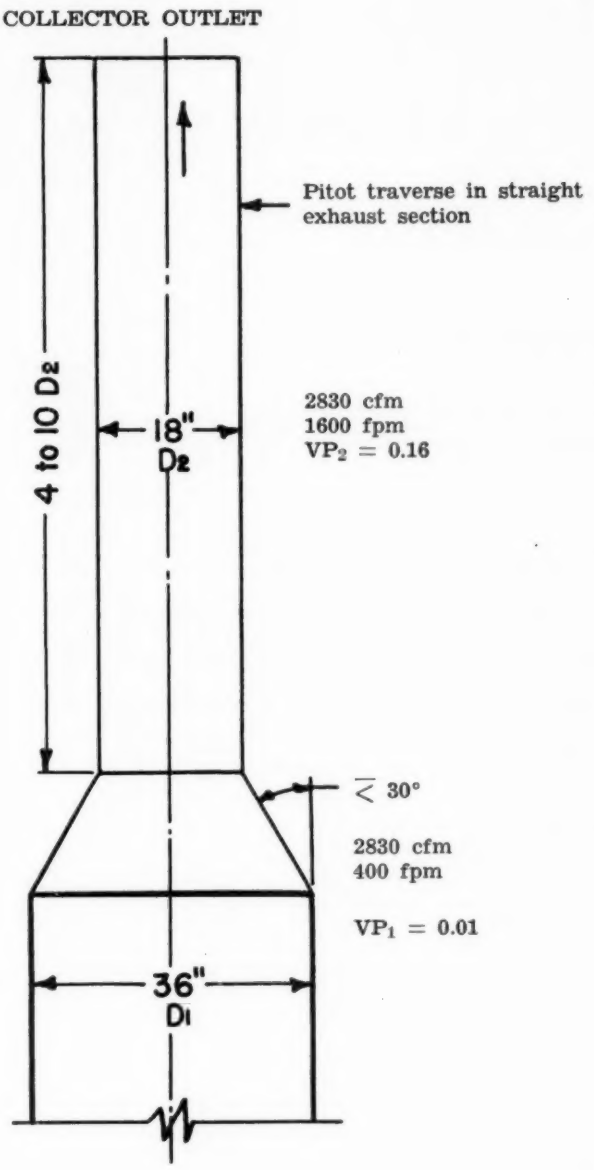
Answer:

Where use of the Pitot tube for measuring duct velocities is unsatisfactory because of low velocity ranges, as is the case here, and where the presence of contaminants such as dust and water droplets rules out the use of other instruments possibly applicable to the 150-300 fpm range, the only practical alternative is modification of the collector outlet with a tapered type fitting so as to increase the velocity to a measurable value.

This problem is frequently encountered in the field, particularly where certain designs of wet collection devices are used and where the outlet duct is intentionally made large so as to decrease the outlet velocity and minimize water entrainment. The low velocity range mentioned makes air flow determination difficult and similarly complicates the stack sampling procedure where the latter is to be done.

The installation of a tapered outlet where the taper has an included-angle of 60° or less and where the straight outlet stack section can be made of such a diameter as to satisfy the use of the Pitot tube (velocity $\geq$ 800 fpm), is a relatively simple technique. The outlet stack should be from 5 to 10 diameters in length and a double Pitot traverse should be run in the straight section. The system resistance or the static pressure loss attributable to the added fitting is calculated on the basis of the gradual contraction and the length of straight duct added to the collector. Usually this loss is low and will not upset system performance.

Even where contaminants are not present, this technique which enables the use of the standard Pitot tube is more satisfactory than one dependent upon the use of the other instruments mentioned. Such instruments require frequent calibration, are not rugged and are difficult to use for traversing a duct opening. ▲▲



Calculation of increased system resistance due to tapered section:

1. Abrupt contraction
$(VP_2 - VP_1) + L(VP_2 - VP_1) = (0.16 - 0.01) + 0.13(0.16 - 0.01) =$
$0.15 + 0.02 = 0.17"\ H_2O$
2. Straight stack loss (5 diameters high)
$\text{Loss} = \frac{0.19"}{100"} = 5 \times \frac{18"}{12"} \times \frac{0.19"}{100"} = 0.01$ Total = $0.18"\ H_2O$

Taper ∠ (degrees)	L(loss), fraction of VP difference
5	0.05
10	0.06
15	0.08
20	0.10
25	0.11
30	0.13
45	0.20
60	0.30

Tips for Testing Ventilation Systems

PART II

by **Bernard D. Bloomfield**
Industrial Hygienist*

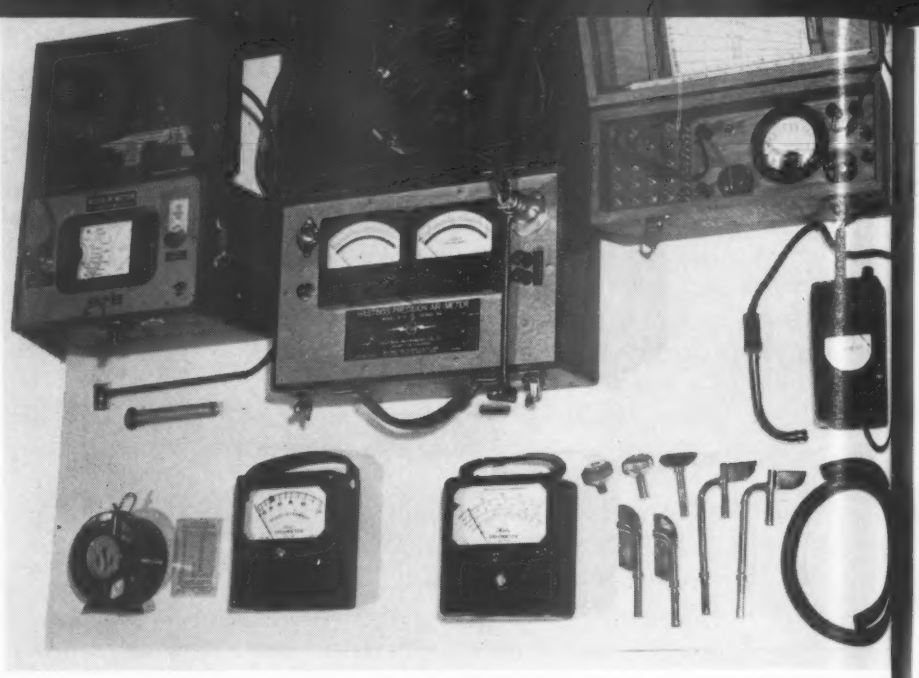


Fig. 3: *Several instruments employed in velocity measurement at exhaust or discharge openings include (top center and left) heated thermocouple anemometers, (top right) heated thermometer anemometer, (center right) heated thermocouple anemometer, (bottom from left) rotating vane anemometer, low range swinging vane anemometer, multiple range swinging vane anemometer, fittings for swinging vane anemometers, and connecting tubing.*

A test in time may save downtime of industrial ventilation systems. Here are practical ways to test your own ventilation systems.

IN PART I, THE AUTHOR discussed the reasons for making the testing of ventilation systems a routine procedure and elaborated on the significance of and method of measurement of such factors as hood and face velocity, velocity pressure, static pressure, and flow rate. He also discussed the characteristics of such instruments as the heated thermocouple anemometer, the heated thermometer anemometer, the rotating vane anemometer, and pressure gauges.

The rotating vane anemometer is illustrated in Fig. 3 and consists of a set of fan blades connected to a gear train. The instrument automatically averages linear feet of air passing through in a measured length of time. It is made in several sizes, 3 in., 4 in. and 6 in. diam., requires frequent calibration and the application of correction factors.

This instrument is not suited to industrial ventilation checking (except for mine work) because of its lack of ruggedness, necessity of frequent calibration, non-direct reading and relatively large finite area. These instruments range from <100 to 10,000 fpm.

The heated thermometer anemometer (Fig. 3) is based on cooling effect of a passing air stream on two thermometers, one containing a resistance winding on the bulb. Current is supplied by an external source in a measured quantity. Temperature difference between the two thermometers permits calculation of the non-directional velocity of the air stream.

The heated thermometer anemometer can be used in exhaust or supply openings in any open area or in ducts. It is accurate if carefully used but slow in response, subject to radiant heat errors and is not direct reading. Lack of ruggedness, together with the above factors, make it unsuitable for field work. It measures velocities ranging from <75 to 6000 fpm.

The heated thermocouple anemometer functions on the basis of the cooling effect of the passing air stream on a heated element. The use of balanced circuits and thermocouple junctions, both hot and cold, minimizes errors due to radiant heat sources and ambient temperature changes. Available with either directional or non-directional probes, the instruments are direct reading. Power supply is by battery or constant voltage transformer on power line.

The instrument lacks ruggedness, requires frequent calibration and is not generally suited to industrial atmospheres where testing is done because of presence of dust and corrosive gases. It is available in ranges of from <100 to 6000 fpm.

Manometers – The U-tube, either vertical or inclined and containing manometer oil (SpG of 0.78–0.82), is commonly used with the Pitot tube. The manometer scale is usually drawn to read in inches of water. The instrument should be carefully calibrated, particularly for low pressure range use. Since accuracy of the inclined manometer is a function of slope of tubes, base should be carefully leveled.

**Assistant Director, Division of Occupational Health, Michigan Department of Health.*

Commercially made manometers usually have an inclined tube, a fluid reservoir, a liquid level adjustment and a built-in instrument leveling device.

The Whalen and Hook gauges are more suited to low pressures (<0.04 in. water) and also serve as calibration devices. These instruments require extremely careful use and are not suited to field use. Recent improvement in mechanical pressure gauges such as the Magnehelic indicate satisfactory field use possibilities. Again frequent calibration is important.

Exhaust System Evaluation

Following completion of a new installation, measurements at marked points are taken at hood faces in each branch duct and in main ducts to assure that:

1. Exhaust volumes agree with design data.
2. Contaminant control is accomplished and to. . .
3. Record velocity and static pressure values measured at specific points for future reference.

The data will indicate flow rates, velocities and static pressure values in the system, enabling comparison with original design values and balancing where required. Particular attention should be given to hood design effectiveness in terms of successful contaminant control. Frequently, minor changes in hood shape, such as baffling to minimize short circuiting or locating or extending the hood close to the contaminant source, makes the difference between satisfactory and unsatisfactory contaminant control.

Where no system performance record exists for *existing* installations, the task of measuring the hood face velocities, branch duct velocities, flow rates and hood suction values is necessarily done as a means of complete evaluation. Only in this way can one determine if transport velocities are sufficiently high, the degree of "balance" of various branch ducts satisfactory and if and where additional branches might be added to the system.

As noted, the hood static suction value is useful as a performance index, but as an unrelated abstract measurement it is meaningless. (This is contrary to the few codes and ordinances specifying minimum hood suction values.) True, if one knows the hood entry coefficient and the branch duct diameter, the use of an equation ($Q = 4005\ CeA\sqrt{SP}$) will enable an approximate flow rate determination.

Where hood suction values are recorded, following final balancing of a system, they do serve to indicate performance changes at the time of subsequent (and necessary) periodic checking by virtue of increase or decrease in hood suction value.

Assuming that the hood design remains unchanged and the hood is free of any obstructions ahead of the point of measurement, a decrease in the hood suction value indicates a decrease in flow rate. It is also possible for an obstruction in a hood to markedly decrease flow rate and increase hood suction value.

A significant reduction in air flow through a hood or portion of a system is usually due to:

1. Reduced fan performance caused by wear, defective motor or belt slippage.
2. Accumulation (settling out) in branch or main ducts attributable to insufficient transport velocities or stickiness of materials being conveyed. Leakage into systems through loose joints, worn ducts or fittings or through loose clean-out doors also serves to decrease design exhaust volume.
3. Increased pressure drop through air cleaning equipment due to plugging, poor maintenance or improper operation.
4. Branch duct additions to system or changes in blastgate settings, resulting in system unbalance. Where blastgates are used, they should be made tamper-proof following completion of installation and balancing.

Field Test Measurements

A. Determination of system performance by measurement (standard temperature and pressure conditions):

1. Pitot Tube Measurement (See table below).

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1. PITOT TUBE MEASUREMENT OF FLOW RATE

Reading Number	Reading* Location (Inches from duct wall)	Measured Velocity Pressure 1st traverse (inches of water)	Velocity Pressure Correction if any (VP/CF)	Velocity† Equivalent (Ft. per Minute)	Measured Velocity Pressure 2nd traverse (inches of water)	Velocity Pressure Correction if any (VP/CF)	Velocity Equivalent (Ft. per Minute)
1	3/8	0.31	None	2230	0.28	None	2119
2	1 1/4	0.33	None	2301	0.29	None	2157
3	2 3/8	0.33	None	2301	0.29	None	2157
4	3 5/8	0.35	None	2369	0.31	None	2230
5	5 1/2	0.38	None	2469	0.32	None	2260
6	10 1/2	0.36	None	2403	0.35	None	2369
7	12 3/8	0.32	None	2260	0.33	None	2301
8	13 5/8	0.31	None	2230	0.29	None	2157
9	14 3/4	0.30	None	2193	0.28	None	2119
10	15 5/8	0.28	None	2119	0.26	None	2042
				2288			2191

See Table III. †See Table I. Both tables appeared in August issue.

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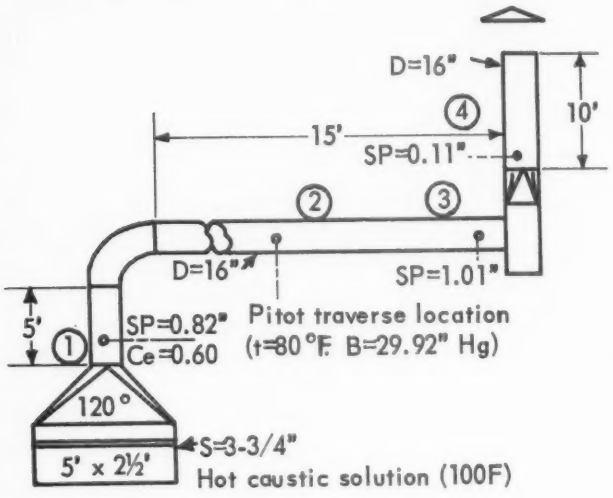


a. Duct velocity (V) $= \dfrac{2288 + 2191}{2} = 2240$ fpm

b. Flow rate (Q) = VA = 2240 fpm × 1.40 ft² = 3140 cfm

Determining flow rate by measuring slot velocity:

Slot velocity measurements with anemometer: 2000, 2400, 2300, 2100, 1900 fpm

a. Average slot velocity = 2140 fpm

b. Q = VA = 2140 fpm × 5′ × $\dfrac{3.75}{12}$ ft. = 3340 cfm

Determining flow rate by measuring hood suction:

$Q = 4005\ A\ Ce\sqrt{SP} = 4005 \times 1.40 \times 0.60\sqrt{0.82}$ = 3050 cfm

Fan static pressure:

SP (fan) = SP (out) − SP (in) − VP (in) = 0.11 + 1.01 − 0.31 = 0.81″ water

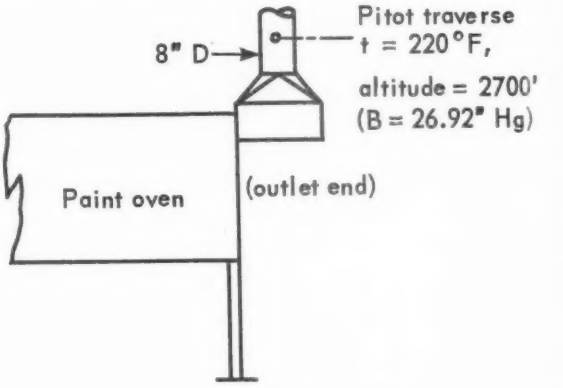
Fan total pressure:

5. Fan total pressure

TP (fan) = TP (out) − TP (in) = [SP (out) + VP (out)] − [SP (in) + VP (in)] = 0.11 + 0.31 + 1.01 − 0.31 = 1.12″ water

B. Example of Pitot traverse calculations for air at elevated temperature and altitude:

1. Pitot Tube Measurement (See table below).



a. Duct velocity, V $= \dfrac{2931 + 2614}{2} = 2773$ fpm

b. Flow rate, Q = VA = 2773 ft/min × 0.35 ft.² = 970 cfm at 220 F and 26.92″ Hg

To correct to standard conditions

$Q(70\ F,\ 29.92''\ Hg) = 970 \times \dfrac{530}{680} \times \dfrac{26.92}{29.92} =$

970 × 0.70 = 679 cfm. ▲▲

1. PITOT TUBE MEASUREMENT OF FLOW RATE

Reading Number	Reading Location (Inches from duct wall)	Measured Velocity Pressure 1st traverse (inches of water)	Velocity‡ Pressure Correction if any (VP/CF)	Velocity Equivalent (Ft. per Minute)	Measured Velocity Pressure 2nd traverse (inches of water)	Velocity Pressure Correction if any (VP/CF)	Velocity Equivalent (Ft. per Minute)
1	¼	0.31	0.44	2656	0.28	0.40	2533
2	⅞	0.33	0.47	2746	0.29	0.41	2563
3	1½	0.33	0.47	2746	0.29	0.41	2563
4	2¼	0.35	0.50	2832	0.31	0.44	2656
5	3⅜	0.38	0.54	2943	0.32	0.46	2716
6	6⅝	0.36	0.51	2860	0.35	0.50	2832
7	7¾	0.32	0.46	2716	0.33	0.47	2746
8	8½	0.31	0.44	2656	0.29	0.41	2563
9	9⅛	0.30	0.43	2626	0.28	0.40	2533
10	9¾	0.28	0.40	2533	0.26	0.37	2436
				2931			2614

‡ As previously noted $V = 4005\sqrt{VP}$ (for air at 70 F and 29.92″ Hg) $= 1096.5\sqrt{\dfrac{VP}{d}}$ where $d = 0.075 \times \dfrac{530}{460 + 200} \times \dfrac{B}{29.92}$. In example above, corrected $VP = \dfrac{\text{measured VP}}{\frac{530}{460 + t} \times \frac{26.92}{29.92}} = \dfrac{\text{measured VP}}{0.70}$

If Beryllium comes to your plant . . . **PART II**

Techniques for Control of Beryllium Dust

Beryllium dust presents tough dust control, ventilation and air pollution problems. This series of articles offers valuable data in control methods for air engineers.

by W. B. Harris, A. J. Breslin, *Health and Safety Laboratory*, and Merrill Eisenbud, *New York Operations Office*, *Atomic Energy Commission*

A CLASSIC EXAMPLE OF BERYLLIUM contamination of the atmosphere occurred in Lorain, Ohio in 1948. Out of a study made of this contamination grew the present maximum allowable concentration and techniques of collection and control. The authors began a description of the collection techniques used in the August issue. Their discussion continues.

In Fig. 4 we show the theoretic fall-off of effluent originating at 33 ft. as compared with an equal amount originating at 185 ft. These curves were computed following the expressions given by Bosanquet and Pearson [1] and Sutton[2] for the average concentration at the ground downwind on the axis of a gas or aerosol cloud originating from an elevated point source. The turbulence parameters stated in [1] refer to industrial urban areas whereas those in [2] refer to "undulating downland." Since turbulence and eddy diffusion are in general greater over a built-up area than over open country, the turbulence parameters used in Sutton's equations for purposes of calculation were not those stated in [2] but rather were computed subject to the condition that both equations would yield the same distance of maximum concentration from the source and that this distance should be that given in [1] by Bossanquet and Pearson.

The curves demonstrate the manner in which the downwind distance of the maximum ground level concentration varies with source height. The maximum average concentration resulting from the 185 ft. stack is seen to be related to that from the 33 ft. source in the ratio of about 1 to 30, assuming equal amounts of effluent in the two cases. Distance of the downwind maximum in the former case is roughly 5 times that in the latter case. These relations may be expected to hold also, to a close approximation, for the case of average concentration at a fixed point, not always downwind of the source, owing to changes of wind direction, say over a season or a year.

A striking relationship will be noticed between the ground level concentration gradient having its source at roof level and the distribution of cases.

It is apparent that atmospheric contamination in the ¾ mile area could be markedly influenced if the exhaust from a portion of the process were discharged via the 185 ft. stack instead of at roof level. We therefore obtained from the plant management a record of the dates when such changes were made and in addition, the dates when existing air cleaning apparatus was installed. These are also

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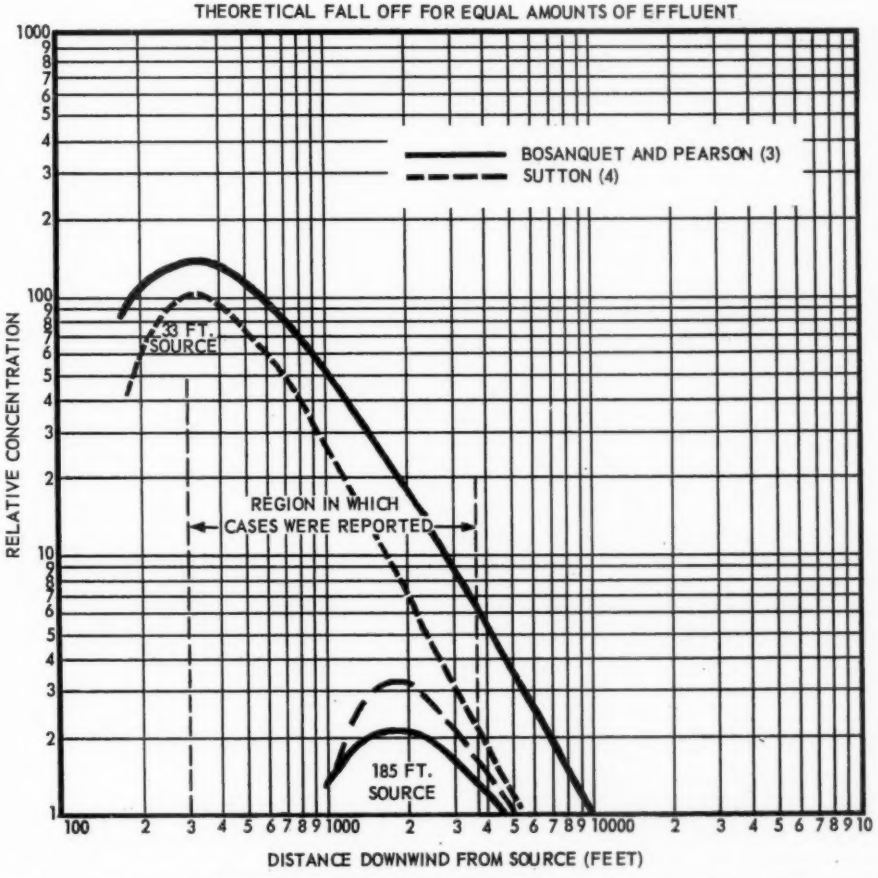

THEORETICAL FALL OFF FOR EQUAL AMOUNTS OF EFFLUENT
BOSANQUET AND PEARSON (3)
SUTTON (4)
33 FT. SOURCE
REGION IN WHICH CASES WERE REPORTED
185 FT. SOURCE
RELATIVE CONCENTRATION
DISTANCE DOWNWIND FROM SOURCE (FEET)

Fig. 4: *Theoretic fall-off of effluent originating at 33 ft. as compared with an equal amount originating at 185 ft. These curves show how downwind distance of maximum ground level concentration varies with source height. Maximum average concentration from the 185 ft. stack height is related to that from the 33 ft. stack height in the ratio of about 1 to 30 (assuming equal amounts of effluent in the two cases).*

TABLE 4—CHANGES IN MEANS OF EFFLUENT DISPOSAL AND THEIR INFLUENCE

Date of Change	Change or Addition	Est. 185 Ft. Stack Effluent gm/day (before change)	Est. Roof Effluent gm/day (before change)	
2/44	Cottrell added to sulfating mill—connected to stack	1700	5000	
6/45	Fluoride furnace connected to stack	1800	4900	
6/46	Collector provided for ore crusher*	——	no data	
2/47	Scrubber added to fluoride condenser	3100	no change	
7/47	Larger scrubber added to ammonium fluoride condenser	2800	no change	
8/47	Dust collector added to beryl furnace*	no data	no data	
2/48	BeCu furnace operation ceased	no change	3500	
4/9/48	High frequency connected to stack	2300	1200	Period of Test
5/5/48	Wet plant to connected stack	negligible change	negligible change	Period of Test

*This unit is of intermittent operation. No noticeable elevation of neighborhood concentrations occurred when the beryl furnace or ore crusher was in operation.

(Continued from preceding page)

shown in Table IV.

Studies of the exhaust system in this plant were carried out to obtain the following information: 1) volume of air exhausted from each operation, 2) quantity of beryllium exhausted from each operation, and 3) collection efficiency of air cleaning equipment in use at the time of the study. With this information and the data on changes in the procedures of handling exhaust air, a reconstruction of past operating conditions could be made as illustrated in Fig. 5, which shows schematically a typical exhaust system discharging through a dust separator to the 185 ft stack.

Studies were made at points A and B in this system, and the quantities obtained are shown. Also shown are the dates when the individual collectors were installed and the time when this discharge was connected to the stack. Prior to this time the effluent was discharged at roof level. In this way, by studying each operation, we were able to estimate the mass rate of beryllium emission from the plant at any time during the period from 1940 to the time of our study.

How Tests Were Conducted

Our tests were conducted using usual technics and procedures. Volumes of air were measured by pitot tube in each of the exhaust ducts, and the quantity of beryllium being discharged was measured by inserting a 0.3 in. copper tube with interchangeable isokinetic jets. For dry particulate contaminants the sample was collected on Whatman #41 filter paper, and for acid mists the sample was passed through a midget impinger which was backed up by filter paper. The results of this study are tabulated in Table V.

No persons definitely affected by beryllosis attributable to atmospheric pollution are known who had not lived for a significant period within ¾ mile from the plant. The X-ray survey sample covered about 10,000 people reasonably uniformly distributed up to 1½ miles from the plant. Moreover, no cases of beryllosis beyond ¾ mile appeared as a result of complaints to physicians or local authorities despite considerable local publicity about this disease and offers made by the plant management to provide free X-rays for any one in the community.

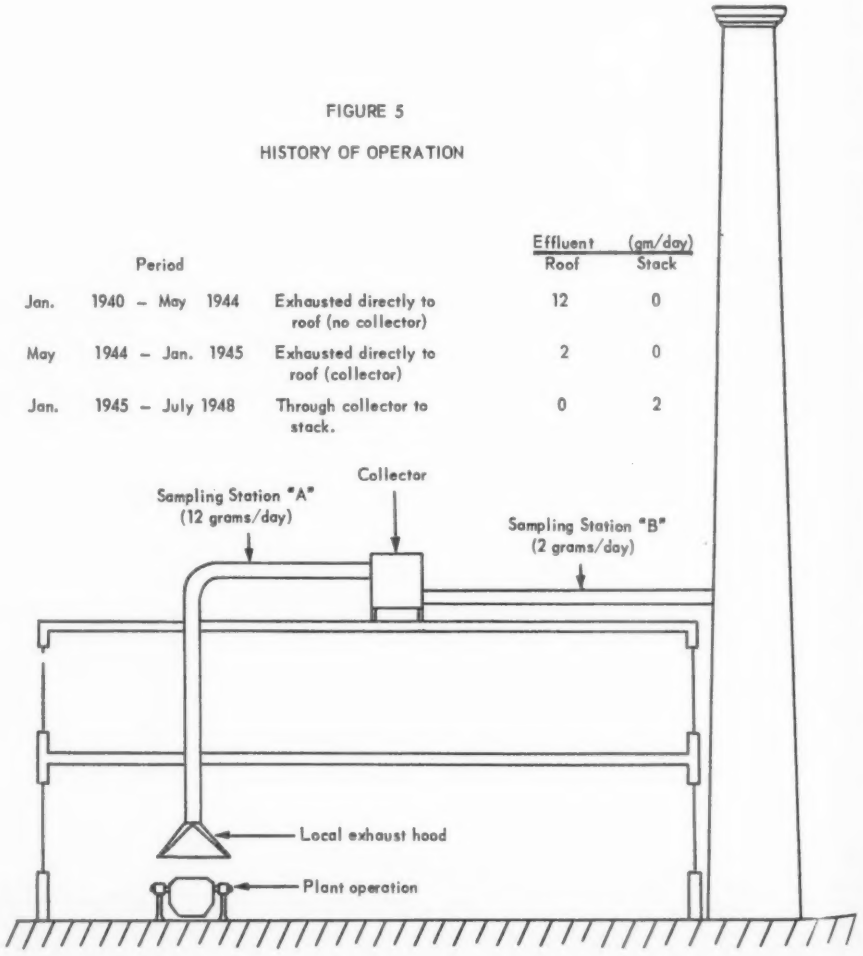
No Cases Beyond ¾ Mile Radius

It therefore seems reasonable to conclude that, at the least, the average concentration which existed ¾ mile from the plant during the 10-week test period had not produced cases during seven years of exposure. It may also be seen from the above data that at no time during the seven-year period was the concentration for any prolonged period significantly lower than that which existed during this test period. It was thus of considerable interest to estimate the average concentration ¾ mile from the plant during this period

FIGURE 5

HISTORY OF OPERATION

Period			Effluent (gm/day) Roof	Stack
Jan. 1940 – May 1944		Exhausted directly to roof (no collector)	12	0
May 1944 – Jan. 1945		Exhausted directly to roof (collector)	2	0
Jan. 1945 – July 1948		Through collector to stack.	0	2



in order that a MAC could be determined.

Determination of Outplant MAC

We had no continuous data at ¾ mile from the plant, and such data as we obtained at our fixed monitoring stations covered only a limited period. It seemed advisable, to assist in interpolation for the ¾ mile estimate, to compare all the data of our air analyses with calculated concentrations following the two mathematical models referred to earlier.

In Fig. 6 the concentration gradient data of Fig. 3 are exhibited for comparison with calculated curves. Measured data appear lowest in the figure, and the horizontal line through the circle indicates distance variation of the sampler during the period of each test, which ranged from 2 to 4 hours. The circle is centered at the weighted mean position. These measurements were taken serially during daylight hours over a period of 10 days. Concentration is inversely proportional to wind speed, and hence standardization of measured data to a wind speed of 1 mph is readily calculated. The rectangles appearing above the measured data were the result, the vertical dimension being due to the available wind records which are in the form of Beaufort force numbers representing a small range of wind speed.

Both calculated curves for each of two degrees of turbulence are shown. The curves having maxima at 330 ft. represent average turbulence conditions. All are sum curves, obtained through addition of two individual curves computed for 2300 gm per day from the 185 ft. stack and 1200 gm per day from roof level and standardized to wind speed of 1 mph. It should be noted that this is for downwind concentrations. ▲▲

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Next month, Part III will tell what the establishment of a maximum allowable concentration meant to the company and how maximum permissible effluent was determined.

TABLE 5—RESULTS OF TESTS ON AIR CLEANING APPARATUS

Operation	Collector	Concentration: Air Flow cfm	Concentration: Before Collector gm/day	Concentration: After Collector gm/day	Contaminant Produced by Operation
Dry grinding	Bag	530	5800	300	Beryl frit dust
Frit heating	Bag	1000	33	2.5	Beryl fruit dust
Sulfating mill	Cyclone	1500	770	100	Beryl frit dust
Making up charge	Cottrell		100	17	
Dumping	None	2200	7.4		$BeSO_4$ mist
Centrifuge	None	540	2.1		$BeSO_4$ mist
Crystallizing tanks	Scrubber	3500	—	2.1	$BeSO_4$ mist
Rotary kiln } Batch furnaces }	None	5100	1700		} $BeSO_4$ & BeO } dust, fume & mist
Ammonium fluoride condenser	Scrubber	500	560	42	BeF_2 & $BeNH_4F_2$ dust
Be fluoride furnace	None	22,000	550		BeF_2 & BeO fume
Be metal furnace	None	12,000	340		BeO & BeF_2 fume
Melts crusher	Scrubber	600	3.1	1.2	Be & BeF_2 dust
BeCu	Bag	—	—	2300*	BeCu fume, BeO

*Estimated from plant process control data.

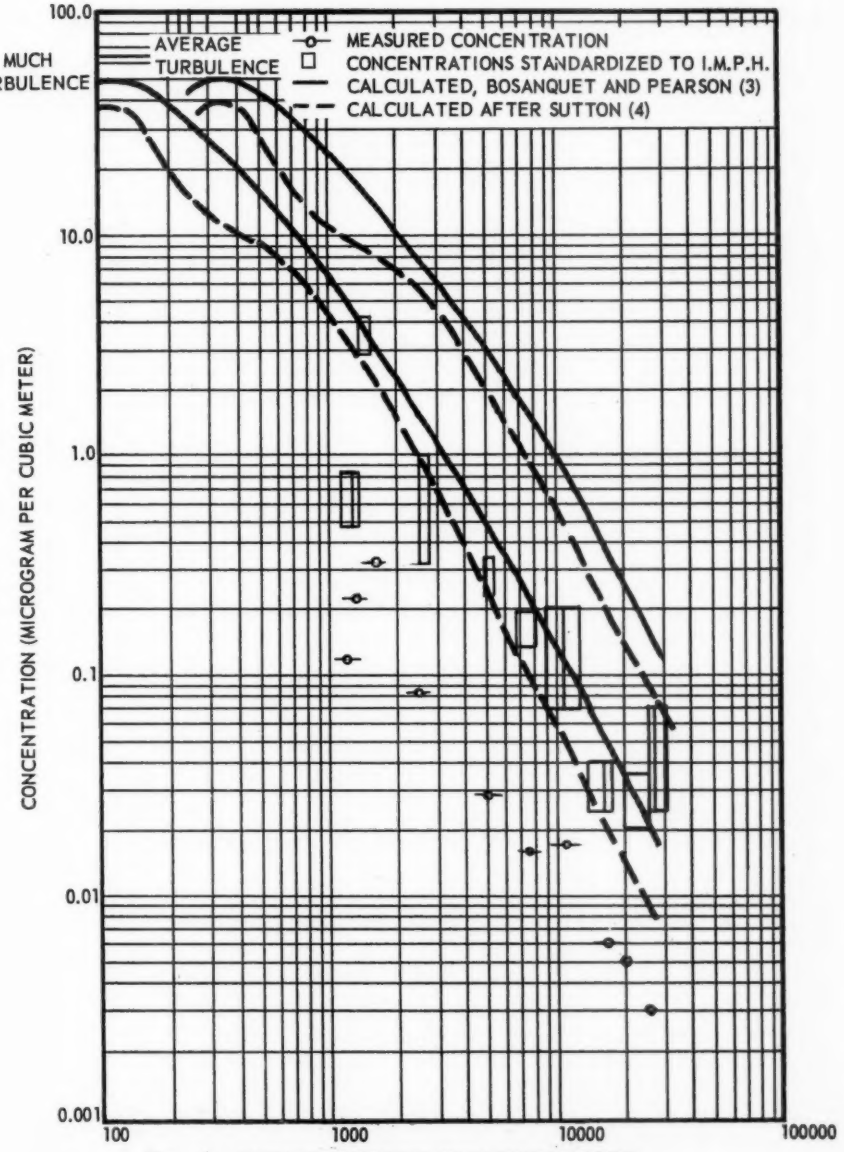

Fig. 6 COMPARISON OF FALL OFF DATA WITH THEORY

by Leslie Silverman, ScD**
Harvard University
and Charles E. Billings***
Harvard University

RESEARCH PROMISES . . .

*Low Cost Cupola Dust Collector** PART III

ABSTRACT

Many processes produce fine particles (0.5μ) suspended in gases at 1000 F or higher, and in current practice temperatures are reduced to utilize available commercial gas cleaning equipment such as electrostatic precipitators, bag filters, etc. Due to high costs of present cleaning methods and increased use of higher temperature operations, there exists a need for devices which will clean gas effectively and inexpensively at elevated temperatures.

Research and development on removal of fine iron oxide aerosols from 1000 F gases reported here is divided into two phases: (1) studies of particle agglomeration by thermal, mechanical devices; and, (2) use of refractory mineral wool fibers for filtration. Successful filtration of iron oxide particles (open hearth furnace fume) has been accomplished in laboratory and field units, and use of rotary agglomerators improves efficiency and extends filter life.

A new cleaning technique for dry filters using blast waves created by exploding diaphragms improves over-all life of the filter. Results of these studies can be applied to effluents from gas turbines, air or gas cooled nuclear reactors, incinerators, boiler flue gases, and many metallurgical processes.

IN EARLIER INSTALMENTS, Dr. Silverman discussed the fundamentals of agglomeration and the methods for increasing it. He also described the performance of a rotary screw agglomerator. In this issue, he continues with filtration at high temperature and pilot tanks.

We have presented requirements for high temperature gas cleaning devices to be used on steel production operations (11) (12) and our developments utilizing slag wool fibers for filter units on open hearth fume (10) (13).

This material was selected because it is inexpensive ($20 per ton), readily available, and can function at temperatures up to 1,000 F. It is used as a deep bed medium 1 to 2 in. thick of 3 to 5 lb. per cu. ft. packing density (97 percent voids). Use of slag wool differs from other filtration techniques in that the gas velocity is maintained at 100 to 150 fpm which reduces space requirements. (Bag filters operate at 0.5 to 2 fpm on fume).

A typical 250 ton open hearth furnace would require about 50,000 cfm at 500 F or 500 sq. ft. of filter surface. The filter is produced by a wet slurry process and sucked on to a moving belt or disc, or formed on a perforated or screen surface. It is dewatered by suction and dries rapidly when exposed to hot gas.

On open hearth fume the filter has given satisfactory efficiencies of 95-99 percent if mechanical leakage is eliminated. On laboratory fume, the resistance reaches an undesirable value when the fibers have taken up 5 percent of the basic filter weight. Field trials showed that by weight approximately 10 percent of the initial filter weight was removed before undesirable resistances were reached.

Laboratory and field tests indicated the fiber could be washed and reused eight to 10 times. This

* Presented at the Semi-Annual Meeting, American Society of Mechanical Engineers, St. Louis, Mo., June 14-18, 1959. This report is based upon work performed under a contract between Harvard University and the American Iron and Steel Institute, through its subcommittee on Air Pollution Abatement.

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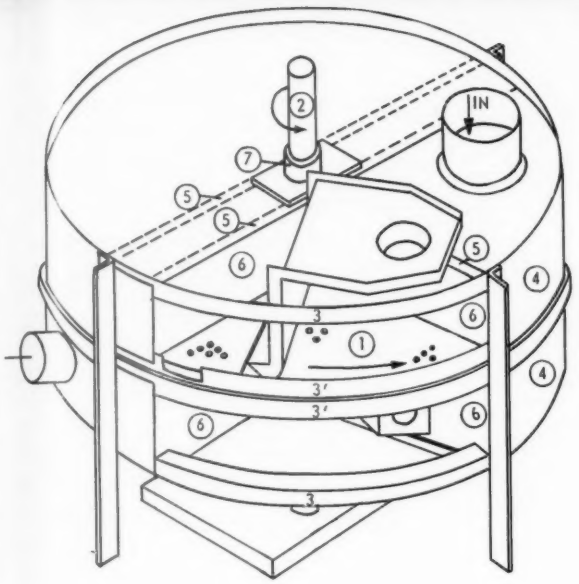
***Assistant Professor of Industrial Hygiene, Associate Member, ASME.


IN
1 4' DIAM-10 GA HRS. PL. PERF. 1/4" ON 3/8" CENTERS-STAGGERED
2 3" ID-1/4" WALL-40" L S'ML'S STL. TUBING
3 8 3' 2"x2"x1/4" HRS ROLLED RING-49" D
4 16 GA HRS
5 2"x2"x1/4" HRS
6 16 GA HRS
7 TAPERED ROLLER BEARING

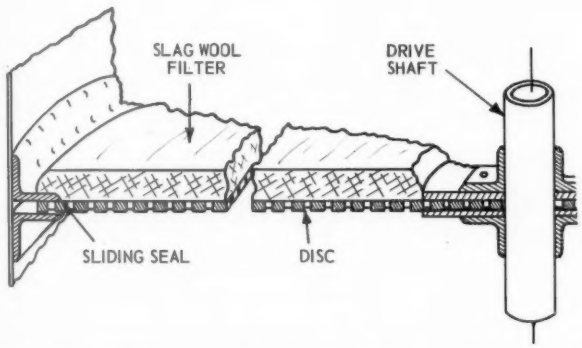


Fig. 3: *Continuous slag-wool filter for open hearth fume-pilot plant 2.*

provides an economical utilization factor, as a requirement of 4 tons per day of fiber would take care of an average 250 ton furnace.

Recent efforts have been directed towards perfecting the use of the wool in pilot plants and to minimize the amount of fiber to be handled. Since 1 percent slurries have been the most satisfactory, the storage and washing systems constitute space and equipment costs which can be reduced by dry handling or dry cleaning in place.

Pilot Plants

In order to evaluate the slag filter method on a reasonable scale, we have gone from laboratory units of 25 to 50 cfm to 750 to 2,000 cfm pilot plants. Table 5 summarizes pilot plant development to date.

Pilot plant 1, the moving belt unit, was successful in demonstrating the slurry handling and dewatering technique but had mechanical seal and leakage problems. When the belt was held in place and sealed, performance in the field compared to laboratory results in the 90 percent range.

Because of these real problems and also a desire to provide a design which would occupy no more space than that occupied by a stack, the cylindrical disc design-Pilot plant 2, was constructed. This unit (Fig. 3 (a) (b)) performed better than the belt unit when the disc was rotated, but also showed some fume leakage which was not eliminated by the simple sliding seal.

When stationary, field tests gave an average efficiency of 90 percent. It was felt that minor redesign to provide a positive seal with sequential indexting of the disc would result in uniform efficiencies greater than 90 percent. Higher removal can be obtained with denser filters and higher air flow resistance.

On the basis of Pilot plant 2 studies, a 10 ft. disc unit was designed, Pilot plant 4[1], utilizing a metal skirt with a positive liquid seal and sequential indexing. This unit would handle 7,500 cfm but was not built because of other promising developments.

Pilot plant 2 was rebuilt for another approach study in the laboratory and designated as Pilot plant 3. Wool can be prepared in a nearby cupola and used to make a dry bed as in insulation manufacture. When the wool has served its effective period as a filter it can be remelted thus concentrating the iron oxide in the slag. Since wool can be made with iron content up to 35 to 40 percent this did not appear to be a limiting problem.

This design was investigated in the laboratory with a small cupola as well as using resuspended wool. Because of other mechanical problems in the construction of the original unit it was shelved and the principle of the method will be explored in a larger unit. Summarized performance data for Pilot plants 1, 2 and 3 are reported in Table 6.

We are currently field testing Pilot plant 4A, B and C (Fig. 4)

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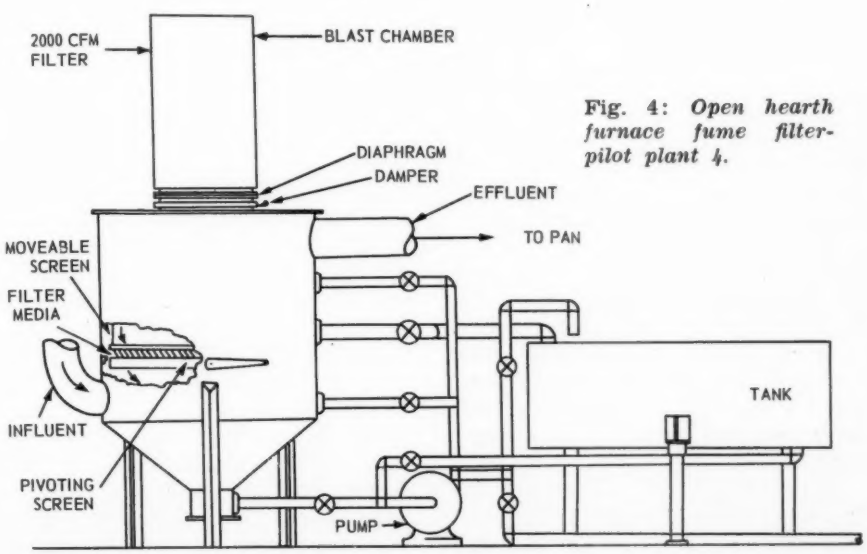

Fig. 4: *Open hearth furnace fume filter-pilot plant 4.*

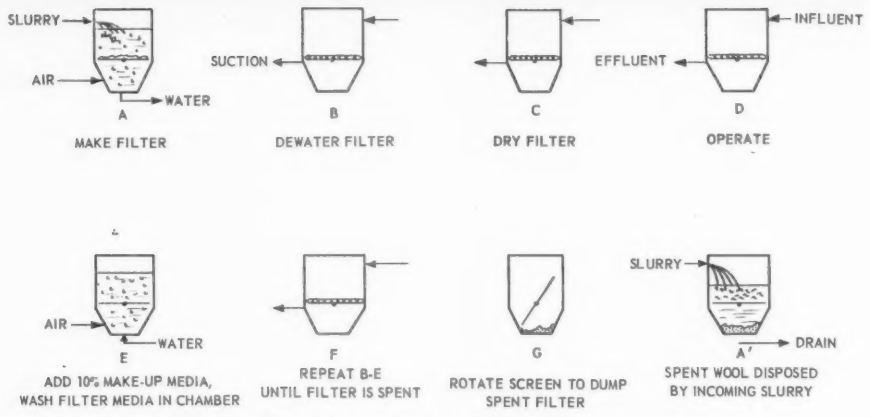

Fig 5: ***Operation of pilot plant 4A (Reslurry).***

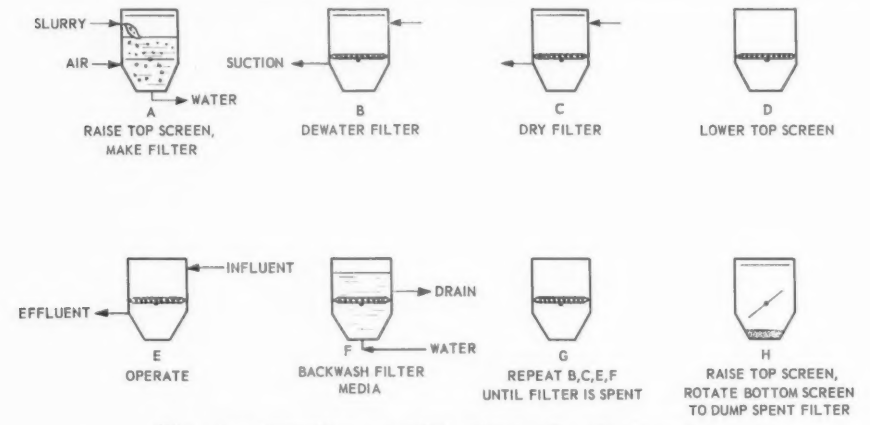

Fig. 6: ***Operation of pilot plant 4B (Backwash).***

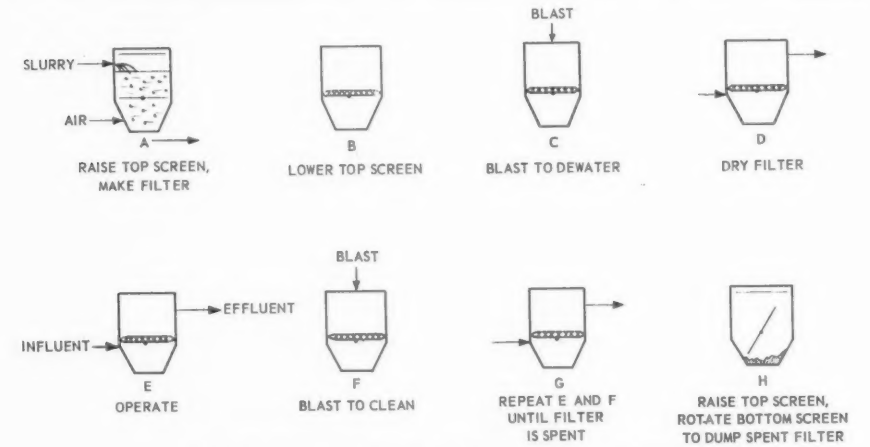

Fig. 7: ***Operation of pilot plant 4C (Blast).***

(Continued from preceding page)

which incorporates all design features studied in the laboratory to date. A 5 ft. disc which can be rotated (pivotally) on a diameter for dumping the bed forms the filter screen and preparation surface: at 100 fpm it will have 2,000 cfm capacity: gas and liquid flow can be upward or downward. All filter beds are prepared by slurrying.

When designated 4A (Fig. 5) the filter bed is formed on the top and dewatered by draining and drawing dry air through the bed as in Pilot plant 2. In principle two such units could give continuous operation by valving and dumping the filter bed by inverting the screen on its diameter by rotation. The lower filter chamber then permits the used filter to be transported by the water drained from the new bed.

When designated as 4B it is assumed that water can be admitted below the filter causing it to be washed and reslurried in the upper chamber. After a small addition of new slurried fiber to take care of losses the cycle is the same as in 4A. The waste material and broken fibers go to disposal tanks as in the washing process of Pilot plant 2. The slurrying in place is essentially a refinement of our usual washing method.

When designated as 4C (Fig. 6 and 7) the filter bed is formed as in 4A and 4B. The upper screen can then be lowered to maintain the filter in place. The dry filter can then be cleaned by any of the following approaches which proved satisfactory on a laboratory scale.

(a) Reverse flushing with water (Fig. 6) carrying off dirty fluid and entrained waste fibers and oxide by valving to waste tank. This simulates water purification in rapid sand filter plants.

(b) Utilizing reverse water flow, pulsating or shock waves in the water line can be introduced by diaphragm or interrupters. Essentially the bed can be exposed to pulse column washing treatment.

(c) This involves dry treatment with blast waves (Fig. 7) produced by the exploding paper diaphragm technique discussed in the next section. In this pilot plant the blasted fume would pass into the primary agglomerator and cyclonic separator unit.

Next Month, Part IV. ▲▲

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TABLE 5

Description of Slag Wool Filter Pilot Plants for Open Hearth Fume

No.	Filter Carrier	Filter Forming Method	Lewatering	Filtering Area sq. ft.	Filtering Gas Vol. cfm	Filter Travel Rate	Filter Cleaning Method
1	Woven Wire Belt Conveyor 24" wide	1% slurry to external-inclined screen similar to Fourdrinier Machine	Gravity	5	500	1-4 ipm	Batchwash in 300 gal. tank by hand
1A	Articulated flat panel 3' wide x 6'	1% slurry directly onto panel by suction roll in 300 gal. tank	Gravity	18	1800	..	
2	Perforated 10 ga. steel disc, 4' diam.	Poured 1% slurry onto slowly rotating disc, turned from central shaft	Suction box beneath disc	7.5	750	13 min/ rev.	Continuous external wash and separation of wool from wash on rapping screen
3	Perforated 10 ga. steel disc, 4' diam. separated into 30° segments with 1" high dividers	Dry wool blown into 30° plenum 1' high, compressed to ½" by ram, indexed by cent. shaft	None required	7.5	750	13 min/ rev.	Under development
4	Expanded metal screen in 30° segments on 10' diam. disc	See below	See below	70	7000	10-15 min/ rev.	See below
4	Expanded metal screen on 5' diam. disc, stat. but can be turned upside down to dump used filter	8' high x 5' diam. tank filled with water, add wool and agitate with comp. air, drain water to form filter on screen	Suction or shock	20	2000	None	A. Clean and reconstitute in place as in col. 3, adding wool makeup as required B. Wash in place with backflow of water C. Shock wave from 24" diam. rupture diaphragm

Remarks

1. *Compressed air and mechanical agitation used to disperse slurry. Slurry flow by gravity from head tank-field tested.*
1A. *Development stopped before complete.*
2. *Compressed air agitation of slurry. Slurry pumped from main mixing tank by compressed air pump to overhead surge tank, and through filter and wash cycles by gravity—field tested.*
3. *Dry wool formed from 25 lb./hr. cupola furnace and slag. Wool spun and blown directly into filter unit—not field tested.*
4. *Design stopped before complete.*
4. *B and C filter cleaning methods use a second retaining disc brought down to hold wool while cleaning.*

TABLE 6

Characteristics of Slag Wool[a] Filter Pilot Plant Units on Open Hearth Fume

PP. #	Filt. Thick. Inches	Char. Pack. Dens. lbs/cu. ft.	Oper. Temp. °F	Filt. Vel.[b] fpm	Filt. Resis.[b] in. water	Inlet Load.[c] gr./cu. ft.	Filt. Eff.[d] % Wt.	Oper. Time Min.	Life Factor[e]	Remarks
1	1	6.8	650	85	4.8	0.10	55	1700	17	35% Iron Oxide in inlet load. Values in () are range of averages.
	(0.75-1)	(3.9-9.2)	(400-700)	(50-115)	(3.9- 6.6)	(0.06-0.25)	(31-89)	....		
2	1	3.9	540	83	4.1	0.11	44	1311	..	Cont. oper.—no aggl.
	(0.5 -1.25)	(2.6-6.4)	(320-750)	(53- 97)	(2.8- 6.3)	(0.04-0.21)	(34-65)	....	..	22% Iron Oxide.
	1	2.8	230	62	6.4	0.05	60	542	..	Cont. oper. with aggl.
	....	(2.0-3.6)	(220-260)	(52- 72)	(4.8- 7.6)	(0.04-0.07)	(48-78)	....	..	Inlet temp. to screw = 860° F.
	1.5	3.7	740	76	6.0	0.12	75	183	14	Stat. oper.—no aggl.
	(1.25-1.5)	(3.0-5.5)	(630-840)	(58- 85)	(1.1-10.8)	(0.04-0.31)	(42-98)	....	..	
	1.5	3.4	250	70	6.3	0.09	90	424	22	Stat. oper. with aggl.
	(1. -1.75)	(2.6-4.9)	(200-380)	(53-120)	(1.3-11.0)	(0.02-0.19)	(75-98)	....	..	Inlet temp. to screw =900° F.
3	2	3	70	100	..	0.01	48	27	..	Lab. tests with simulant fume.

a. *Mineralite-Bethlehem Mineral Wool.*
b. *At temperature indicated in column 4.*
c. *Volume STP.*
d. *Based on total weight.*
e. *Lbs. fume per 100 lbs. fiber per inch water.*

(Continued from page 16)

Pitch Sensitivity Velocity Probe

United Sensor has developed a new cylindrical probe, made in sizes as small as ⅛ in., used to measure total pressure, static pressure, and yaw angle at any point in an air stream. It is supplied with its own calibration curve and is insensitive to pitch angle up to 15 degrees from normal to the axis of the probe.

It is useful chiefly in measuring the velocity and flow directions in liquids or gases in such applications as pumps and turbines.

Source: *United Sensor & Control Corp., Dept. AE, Box 127, Glastonbury, Conn.*

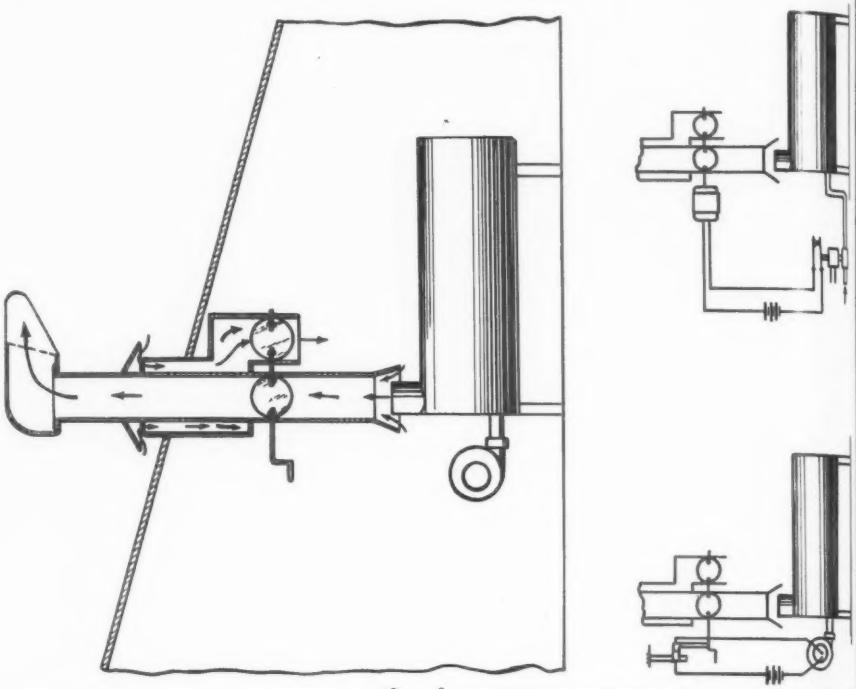
Plate Glass Heat Shield

A plate glass heat shield which reflects 65 percent of long wave infrared has been developed for protection and comfort of personnel working near intense heat.

The window of tempered Pyrex glass is covered with a thin, transparent metallic film. The heat literally bounces off the coating which is permanently bonded to the glass. The glass itself does not become hot.

Shield can be used in foundries; metallurgical, power, glass, and oven plants; television and movie studios, and laboratories.

Source: *Corning Glass Works, Dept. AE, Corning, N. Y.*



Compensating Flue System

A patented Compensating Flue System insuring adequate air supply under all conditions of operation has been developed. Design of system features twin dampers controlling flue and air inlet openings at the same time and by the same operator. Dampers may be controlled by limit switches for open position start, and closed position for shutdown of combustion equipment.

The Compensating Flue System was developed to meet the requirement of any blast-fired gas furnace, boiler, or other heating device for a minimum of 10 cu. ft. of air for each 1000 Btu of fuel burned.

All of the air required by the combustion system is replaced by new air entering the sleeve opening through the roof. Design of the fresh-air sleeve is such that it not only insulates the hot exhaust flue from contact with the roof but provides partial preheat of fresh air coming into the boiler or furnace room. An optional freely rotating wind cap aids in moving products of combustion from the room.

Source: *Eclipse Fuel Engineering Co., Dept. AE, Rockford, Ill.*

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.

Liquid Drys Out Electrical Equipment

Harmful effects of moisture in electrical equipment can be eliminated by the application of CRC Moisture Inhibitor, a chemical liquid which drives out absorbed moisture and keeps it out. CRC eliminates the effect of wicking, reduces electrical failures and costly downtime.

Although CRC is non-conduct-

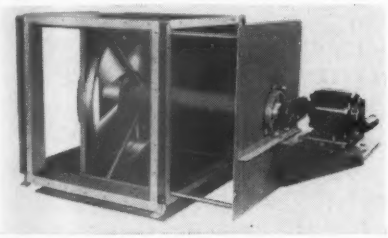
ing, it does not interfere with conductivity of contacts or commutators. It prevents corrosion of ferrous and non-ferrous metals with a long lasting, continuous, molecular film that completely blankets the surface.

Under most conditions one application will provide full protection for at least a year. Hygienic tests have proved that it is safe to use and is non-toxic to humans.

Source: *Corrosion Reaction Consultants, Inc., Dept. AE, 116 Chestnut St., Philadelphia 6.*

Packaged Elbow Fans

New design of elbow fan for general ventilation and for use with such equipment as furnaces, dryers, ovens, kilns, and plating and



pickling tanks, has been introduced.

Standard units can handle clean or slightly contaminated air or fumes at normal or elevated temperatures. Special construction accommodates corrosive or explosive conditions. Installed in ductwork, the unit occupies only slightly more space than a standard elbow. A choice of three inlet connections is provided.

Wingflow elbow fans are available in five basic sizes with a wide choice of motors, for capacities from 600 to 32,000 cfm at static pressures to 2 in. or more. Standard fans can handle up to 750 F. Higher temperatures can be accommodated by admitting diluting cooling air.

Source: *L. J. Wing Mfg. Co., Dept. AE, Linden, N. J.*

Glass Fiber Duct Liner

Ultralite®, glass fiber duct liner is now available with a newly developed-and-approved gray fire resistant coating. The new product carries a flame spread classification of less than 25, and complies

with all the requirements of the National Board of Fire Underwriters' Bulletin #90-A and B and the strictest fire codes everywhere. Ultralite duct liner carries an Underwriters' Laboratories label.

Source: *Gustin-Bacon Mfg. Co., Dept. AE, 210 W. 10th St., Kansas City, Mo.*

Fan for Ventilating Electronic Equipment

Low cost, lightweight tubeaxial fan has been designed for ventilating electronic equipment.

Designated air moving unit No. 89B222, the new fan may be used for ventilating cubicles, racks, and cabinets housing electronic equipment. It is recommended for use in stationary commercial equipment where shock and vibration are negligible.

Mounted in an open type enclosure, the new unit is equipped with sleeve-type bearings and is powered by a 1/70-hp. shaded pole electric motor operating on 115-v, single-phase 60/50 cycle current.

At rated speed, the No. 89B222 fan will deliver 450 cfm of air at zero static pressure and 100 cfm of air at approximately 0.22 in. w.g. static pressure. The new air unit weighs 8 lbs. and installs in a 9-in. circular opening with 11½-in. by 11½-in. mounting plate.

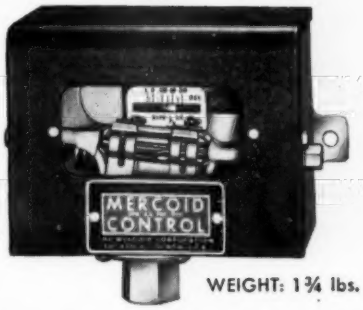
Source: *American-Standard Industrial Div., Dept. AE, Detroit 32.*

NEW

Small, Lightweight

MERCOID PRESSURE CONTROL

AP-153

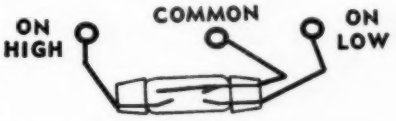


WEIGHT: 1¾ lbs.

FOR MEDIUMS NOT INJURIOUS TO STEEL OR SILVER SOLDER

CIRCUIT

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)



Provides any of following operations:

1. *Single Pole—Cut-in high (close on rise)*
2. *Single Pole—Cut-in low (open on rise)*
3. *Single Pole—Double Throw*

OPERATING RANGE

ADJUSTABLE OPERATING RANGE	SWITCH DIFFERENTIAL PSIG. With Pointer Set At LOW	HIGH
1 to 20 psig.	0.3	0.5

CONSTRUCTION

ADJUSTMENT: External
PRESSURE ELEMENT: Fairprene dicphragm
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

WRITE FOR BULLETIN 02

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

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*Not advertising in this issue.

'Air-Borne' Treatment Checks Asiatic Flu

"Air-borne" treatment methods were reported as being successful, at least in experiments carried out thus far, in preventing the spread of Asiatic flu and in vaccinating for tuberculosis, the National Tuberculosis Association was told recently.

The American Trudeau Society, its medical section, has been extending its research into lung and throat infections other than TB.

Ultraviolet light used to treat air in rooms apparently helped prevent spread of Asiatic flu in the Veterans Administration Hospital at Livermore, Calif., according to a study made by Dr. Ross L. McLean.

A group tested by Dr. McLean got as high as 67 percent reduction in the number of Asiatic flu cases at the time of the 1957 epidemic, in rooms which had the air treated with ultraviolet light.

What Dr. McLean and his associates believe is that ultraviolet rays, known to be destructive to certain bacteria and viruses, in some manner blocked the airborne transmission of the Asiatic flu virus.

A new way to be vaccinated—simply by breathing vaccine-containing air—was forecast in the report of a study made to the National Tuberculosis Association.

Experimental work on guinea pigs and 30 humans indicates that breathing germ-laden air may be as effective as the conventional shot in the arm for the administration of BCG, the anti-tuberculosis vaccine.

Members of the medical profession making the report at the meeting stated that they can see no reason why the method could not be used for vaccinations against polio and other diseases.

The new airborne vaccination has been tried in University of Illinois College of Medicine laboratory in Chicago. Placed in a closed room for half an hour, 30 subjects breathed air which had been sprayed with BCG. Later examination showed that the vaccination "took" for 27 of the subjects.

Dr. Gardiner Middlebrook, who did the animal experiments at the National Jewish hospital in Denver, said that it took only a few of the inhaled germs to produce immunity. Only 25 germs were necessary in the airborne vaccination as against the million needed for injection, he declared.

Declaring that the technique is safe and painless, Dr. Middlebrook commented that "it is unnecessary to elaborate on its convenience as a method for individual or for mass vaccination."

Army Tests Shelter Ventilation System

Use of a ventilation system was included in a successful test by the Army of an underground shelter designed to protect troops against the effects of atomic weapons. The prototype shelter was developed and tested at the Army Engineer Desert Test Station, Yuma, Ariz.

PROFESSIONAL SERVICES

LAUREN B. HITCHCOCK ASSOCIATES
Chemical Engineers
Industrial Air Pollution Abatement
L. B. Hitchcock.....Edwin Cox
John H. Schaefer, Technical Advisor
60 East 42nd St., New York 17, N. Y.

CLASSIFIED ADVERTISING

RATES—Classified advertising is run in 6-point type (this size) under suitable headings. Minimum rate $5.00 for forty words or less. Extra words .15 each. Box addresses, with usual services, count as five words. Payment required with order. No agency commission, no checking copies. Closing date first of month preceding month of issue. No proofs will be submitted prior to running, but proof will be forwarded for record. No display advertising under classified headings. AIR ENGINEERING, 450 W. Fort Street, Detroit 26, Mich.

Oil Industry and Air Pollution

(Continued from page 25)

generation of the catalyst, escape into the atmosphere. An electrostatic precipitator on the cracking unit stack has effectively ended this source of pollution.

New steam boilers have been designed to reduce air pollution in the shape of carbon monoxide boilers. A typical four-story unit can be described as a giant afterburner for the refinery catalytic cracking unit. The boilers burn the waste gases from the catalytic crackers which were formerly discharged into the atmosphere.

The APCD now points to the automobile as the major cause of smog in the Los Angeles area.

To say that the oil industry in the Los Angeles area has completely eliminated its contribution to the air pollution problem would certainly be an overstatement.

But the industry does take pride in studies completed by the Air Pollution Control District of Los Angeles county, the United States Public Health Service, the Department of Public Health in the State of California and the Western Oil and Gas Association.

The report states that pollutants emitted to the atmosphere from all refineries in Los Angeles County have been reduced by 85 percent.

The report further states: "At the present time the petroleum refineries in Los Angeles County have the lowest emissions to the atmosphere of any segment of the industry in the country because of control programs." ▲▲

How To Select Fans

(Continued from page 31)

is a d. r. of .50) 10,000 cfm divided by .5 equals 20,000 cfm. The pressure for reading into the table would be determined as before – by dividing the standard air pressure by the density ratio or ¾ in. ÷ 5 = 1½ in. Again, reading from the sample table (Fig. 4), we would select a fan to deliver 20,000 cfm at 1½ in. static pressure. In this instance, the fan selection is a semi-pressure no. 7-375 with a 10 hp, 1750 rpm motor. Brake horsepower listed for this unit is 9.05. Therefore, actual brake horsepower at operating conditions would be .50 × 9.05 or 4.52 bhp.

These represent the two most common examples of corrections applied to fans selected for operation at other than the standard conditions. It should be noted that when the temperature is below standard, the density ratio is larger than one. Actual brake horsepower, therefore, would be greater than horsepower in the tables. This density ratio would be used in exactly the same way. Always correct the specified capacity to standard air conditions before reading into the fan selection tables. ▲▲

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next month - - -

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Write on your letterhead or use
the handy order card in this issue.
Be sure and state your company
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Circulation Manager
AIR ENGINEERING
450 West Fort Street
Detroit 26, Michigan

1 year, $3.00 — 2 years, $4.50 — 3 years, $6.00

A simple, direct reading on the Alnor Velometer gives you an instant measure of air flow speed through grilles, ducts, furnaces, spray booths, or in the open.

Precision-built and self-contained, this portable instrument brings laboratory standards to the line or field installation. Available in a wide variety of scale ranges, full assortment of jets and fittings. You'll want all the facts (no safety department should be without a Velometer). Get Bulletin 2448-G. Attach this ad to your letterhead and mail to: Illinois Testing Laboratories, Inc., Room 570, 420 No. LaSalle St., Chicago 10, Illinois.

PRECISION INSTRUMENTS
FOR EVERY INDUSTRY

Alnor

Short **SHORTS** . . . *Data Packed Case Histories of Air Engineering Problems and Their Solutions*

The Problem

A pharmaceutical packing plant, located in a district zoned for heavy industry, requires 12,000 cfm of dust-free air for ventilation. What will be dust loading; what filters should be installed; where in the air handling system should they be installed; when should filters be replaced; how much resistance will filters add to system; how can variable system resistance as filters load up be compensated for; what will noise level of selected blower be under minimum and maximum system resistance?

The Solution

Dust loadings will range from 0.2 to 2.0 grains per 1000 cu. ft. of outside air. Experience tells us that coarse dust (such as fly ash from pulverized fuel power boilers) will constitute a sizeable fraction of the dust loads.

Absolute type filters should be installed, with pre-filters upstream so as to extend the service life of the more expensive filters. Ventilation system, exclusive of the filter installation (i.e., intake louvers, heating coils, ducts, supply registers, etc.) may have a resistance of 0.5 in. w.g. at 12,000 cfm.

Filter bank resistance will be: pre-filter, 0.45 w.g. at 1000 cfm/filter. When fully loaded: 0.8 in. w.g. The absolute filter has new filter resistance of 0.75 in. w.g. at 1000 cfm/unit and is usually replaced when resistance reaches 2 to 4 in. w.g. Thus if 12 pre-filters and 12 absolute filters are used, system resistance will total 1.70 in. w.g. If absolute filter is allowed to run until its resistance is 4 in. w.g., maximum system resistance will become 5.3 in. w.g.

Therefore, a blower must be selected that is capable of delivering 12,000 cfm against a total resistance of 5.3 in. w.g. Since initial resistance will only be 1.70 in. w.g., an adjustable flow damper must be provided which will introduce an initial added resistance of 3.6 in. w.g. (5.3 in. minus 1.70 in.) into the system. This added resistance will be reduced gradually as filters load up. At maximum filter resistance, damper will be fully open.

Blower noise level and power input increase as air flow resistance increases and power costs increase in direct proportion to the resistance so that it is often preferable to operate absolute filters to lower maximum air flow resistances.

In the present case, a maximum rise to 2 in., instead of 4 would allow the system to operate over a total resistance range from 1.70 to 3.3 in., thereby reducing noise levels, operating expense and initial installation costs.

Supply air systems should be under pressure so that leakage will be outwards and contamination of the ducts prevented. Exhaust systems (containing contaminants) should be under vacuum so that duct leakage is inwards and the contaminants are contained. If more than one air cleaning or air heating device is used, the absolute filters should be located last in the line (i.e. downstream of all other units) so that large particles will be collected by other equipment; but they should not be located so close to air washers or air inlet or discharge openings that they are subjected to moisture from condensation or inclement weather.

The Problem

A precision electronic instrument manufacturer was experiencing up to 20 percent rejects due to the presence of foreign materials, principally dust, in his product. A number of dust sources were suspected and an investigation was made to evaluate dust concentration and size from each. All dust was filtered from known volumes of air from each dust source and the weight increase of the sampling filter was used to calculate total dust loading. Simultaneously, smaller dust samples were collected for microscopic examination to determine optically the nature and size of dust.

The Solution

Analysis indicated that dust entering the plant from out of doors with the ventilation air accounted for only about 20 percent of the rejects due to dirt while the remainder were caused by dust generated in the workroom and disseminated in the recirculated ventilation air. The laboratory data made it possible to specify an economic and effective air filter for both fresh and recirculated air and rejects from this source were virtually eliminated.

The Problem

An A.E.C. contractor, engaged on a nuclear power development project, anticipated scaling of reactor walls under high heat fluxes, and wished to remove the suspended material from the circulating heat exchange gases.

The Solution

The nuclear power reactor was simulated with electric induction heating elements and dust samples were withdrawn from the gas streams on ceramic fiber filter papers. The collected dust was weighed and examined under the light and electron microscopes for size distribution. Dust loadings were found to be less than 0.05 grains per 1000 cu. ft. and no particles less than 0.2 microns were found. Therefore, it was concluded that an all-ceramic filter without a pre-filter would retain the particulate matter adequately and would have a service life at least equal to the life of the reactor. The all-ceramic filter, capable of withstanding prolonged exposure up to temperatures of 2300 F, was considered an excellent choice for this severe service.

The Problem

A manufacturer of biologicals was experiencing bacterial contamination of his product in the packaging rooms. The bacterial efficiency of a number of filters for Staphylococcus albus, the test organism, was determined with an electronic bacterial air-sampler.

The Solution

It was found that the F.F.I. F-600 filter paper removed 99.94 percent of the 0.3 micron bacteria. It was concluded that two Airpure filters in series would provide a bacterial retention efficiency of 99.999964 percent and would reduce the probability of contamination to <1 in 10,000,000 units.

All data courtesy Flanders Filters, Inc., Riverhead, N. Y. ▲▲

AIR ENGINEERING

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OCTOBER, 1959

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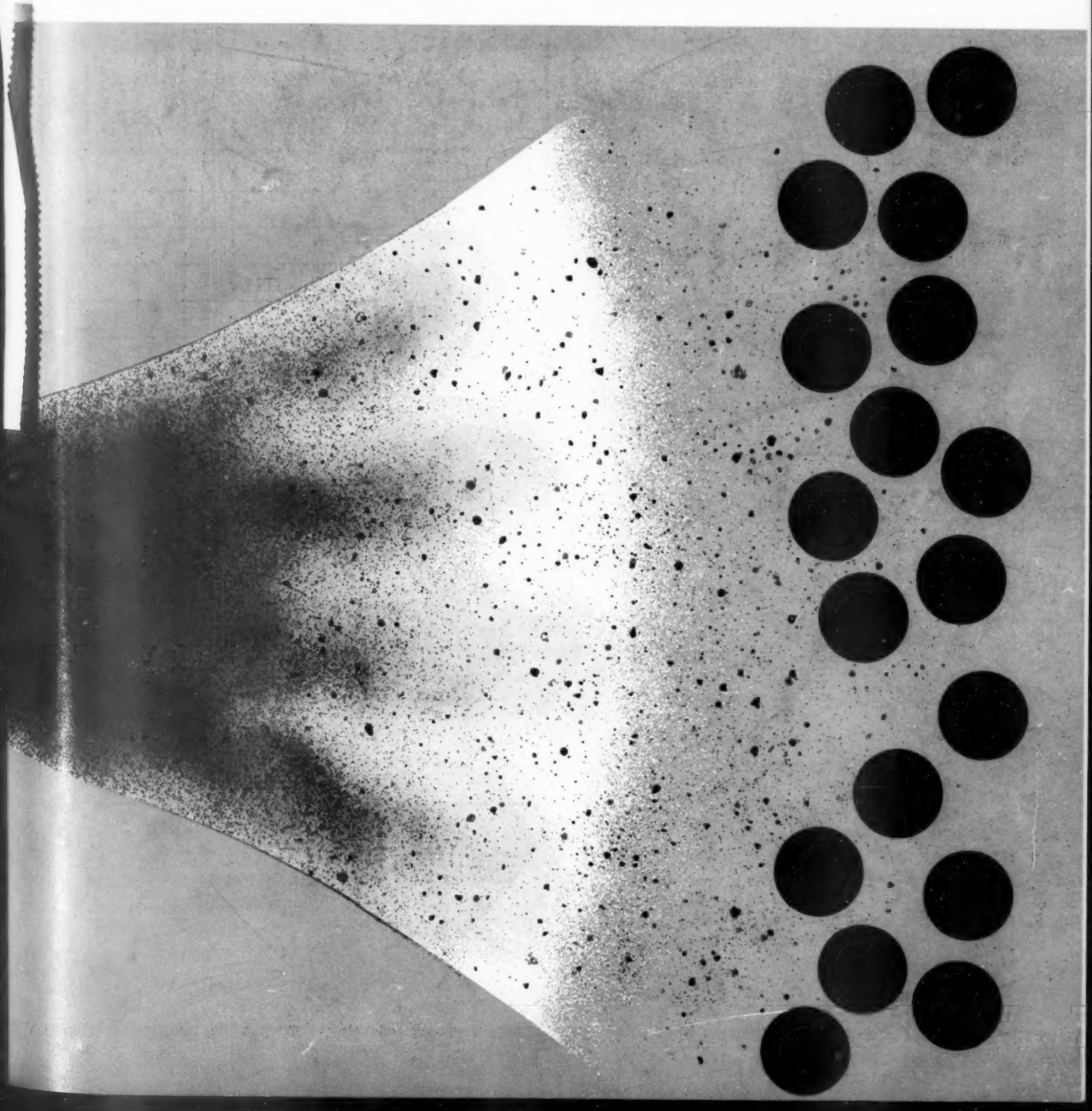
- *For Factory Heating . . . Filter and Outlet Selection Tips*
- *5 Ways To Cut Cooling Costs With Sprayed Coil Dehumidifiers*
- *How Air Conditioning Helps Make Stainless Steel 'Sandwich'*
- *All About Odors . . . Sources, Detection, Elimination*



AIR ENGINEERING

Check this chart to see how Air Engineering's circulation covers the air conditioning, air moving, and air pollution control markets

B = BUYERS

S = SPECIFIERS

R = RECOMMENDING OR APPROVING

	ENGINEERS IN INDUSTRIAL PLANTS, BUILDINGS, INSTITUTIONS	CONSULTING ENGINEERS AND ARCHITECTS	FEDERAL, STATE AND MUNICIPAL AUTHORITIES	EQUIPMENT MANUFACTURERS AND THEIR SALES OUTLETS	MECHANICAL CONTRACTORS
FANS AND BLOWERS	B	S	R		B
AIR FILTERS	B	S	R	B	B
AIR CONDITIONING EQUIPMENT	B	S	R		B
VENTILATORS AND EXHAUSTERS	B	S	R		B
STOKERS, BURNERS, ETC	B	S	R		B
STACKS, CHIMNEYS	B	S	R		B
ODOR NEUTRALIZERS	B	S	R		B
CATALYTIC PURIFIERS	B	S	R	B	B
INCINERATORS AND WASTE BURNERS	B	S	R		B
GERMICIDAL RADIATION	B	S	R	B	B
DUST COLLECTORS	B	S	R		B
AIR WASHERS AND SCRUBBERS	B	S	R		B
SOLVENT RECOVERY SYSTEMS	B	S	R		B
FUME COLLECTORS	B	S	R		B
CONTROLS	B	S	R	B	B
TEST APPARATUS		B	B	B	B
ELECTROSTATIC AIR CLEANERS	B	S	R		B
DUCT WORK AND ACCESSORIES	B	S	R		B

If you sell air moving equipment, industrial air conditioning equipment, or air pollution control equipment, use AIR ENGINEERING to influence these industry groups:

1. AIR ENGINEERING is read by over 6,000 Plant Engineers and other executives in America's largest industrial organizations . . . the men who make decisions to buy!

2. AIR ENGINEERING reaches and influences over 2,300 Consulting Engineers, Architects and Mechanical Contractors . . . the men who design, specify and install equipment.

3. AIR ENGINEERING reaches over 1,700 code enforcement authorities, industrial hygienists, medical researchers and industrial engineering departments . . . the men who are constantly working to improve atmospheric conditions.

This adds up to a concentrated, specialized readership of over 10,000 men directly concerned with the increasingly complex problems of air.

By advertising in AIR ENGINEERING your product is studied by these men directly . . . and you reach them at a time when AIR ENGINEERING's editorial content is making them most aware of air problems. These are the men who are going to be the most vital influences in a growing market. Sell them on your product now!

CONTACT YOUR NEAREST REPRESENTATIVE for Market and Media File, full information and space reservations.

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CHICAGO: Rex Smith, 134 S. LaSalle St., FRanklin 2-8093
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DETROIT: Al Chadburn, Al Schildhammer, 450 W. Fort St., WOodward 2-0924

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MECHANICAL CONTRACTORS

BUELL PUTS "DOUBLE EDDY" TO WORK TO INCREASE FLY ASH COLLECTION EFFICIENCY!

Ordinary cyclones provide limited efficiency in collecting boiler fly ash, because of "double eddy" currents inside all cyclones. But Buell Cyclones make the Double Eddy work to increase efficiency.—The Double Eddy circulates vertically inside all cyclones acting against the normal separating force of the spinning stream of gas and ash. Buell Cyclones have a narrow "Shave-off" port (2) at the top of the casing. This port catches and removes ash trapped in the Double Eddy. It makes the cyclone more efficient instead of less. —Only Buell Cyclones have the Shave-off. And only Buell Cyclones combine this efficiency with large diameter: they will not clog or plug even with loadings up to one pound of ash per cubic foot of gas. No field fitting is needed: they are completely assembled and match-marked before shipment. They can be completely lined, inside and out, against heat, corrosion and abrasion.—For a list of installations near you, a copy of our Catalog 103, or other information, call our nearest representative, listed in the telephone classified directories of most major cities under "Dust Collection Systems". Or write Dept. 62-J, Buell Engineering Company, Inc., 123 William Street, New York 38, N. Y. (Subsidiary: Ambuco Limited, London, England.)

1. Inlet for dust-laden flue gas.
2. Dust Shave-off port.
3. By-pass dust channel.
4. By-pass re-entry opening.
5. Dust outlet.
6. Clean flue gas outlet.

EXPERTS AT DELIVERING EXTRA EFFICIENCY IN DUST RECOVERY SYSTEMS • Cyclones • "SF" Electric Precipitators • Combination Systems • Dry Classification Systems

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Letters

Says Editorial Misrepresents Domestic Incinerators

Editor:

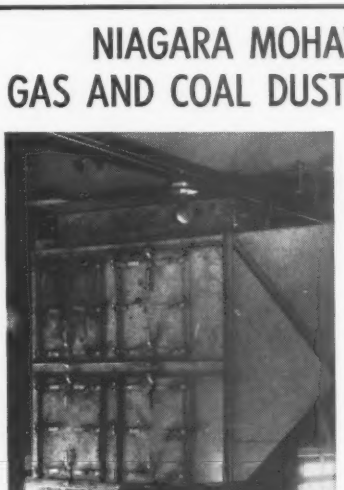
Recently I read in the August issue of AIR ENGINEERING your misrepresented article on residential incinerators versus industrial incineration. We certainly feel that the article would have been in better taste and more accurate if you had taken the time to investigate the merits of the new Smokeless and Odorless domestic incinerator. Quoting one person's opinion —and it is only an opinion—does not justify putting domestic incinerators in a poor light.

Contrary to Mr. Belyea's opinion, cities such as Detroit, Chicago, Cleveland, Cincinnati, Boston, Columbus, Philadelphia, etc., are entirely happy and sure that the Smokeless and Odorless incinerator is the answer to their problems concerning air pollution and trash removal. It might be well to inquire of the air pollution officers on the domestic incinerator. Cities such as Cincinnati, Columbus and Philadelphia who, until recently prohibited all domestic incineration, have rewritten their codes and ordinances based on conclusive testing of the Smokeless and Odorless domestic incinerator. It might be well to investigate the most recent findings of the Battelle Memorial Institute on air pollution and see whether or not they consider the domestic Smokeless and Odorless incinerator a serious offender—this may open your eyes and those of Mr. Belyea.

We have been manufacturing domestic incinerators for over 25 years and are proud of the name we have established in the industry. We are not alone—there are several manufacturers selling fine Smokeless and Odorless domestic incinerators. We would appreciate your giving the domestic Smokeless and Odorless incinerator a fair and concerted investigation. With kind regards, I remain

William R. Hebert
Executive Vice President
Calcinator Corporation
Bay City, Michigan

NIAGARA MOHAWK POWER CORP.* prevents GAS AND COAL DUST ACCUMULATION with

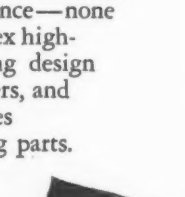


DUSTEX COLLECTORS

Engineers of Niagara Mohawk Power Corp., Buffalo, N.Y., prevented an accumulation of explosive gas and dust at its Huntley Steam-Electric Station — with two Dustex Miniature Cyclone Collectors ventilating bunkers and hooded belt transfer points. Results — gas removed — fines salvaged and returned to bunker continuously. No visible discharge from stacks! Maintenance — none to date, thanks to Dustex high-efficiency, non-plugging design which employs no filters, and Dustex Vacuum Valves which have no moving parts.

SEE FOR YOURSELF the efficient performance of Dustex on your job, at no obligation. Write today for Dustex Bulletin "A Simplified Determination Test."

*Contractors: STONE AND WEBSTER ENGINEERING CORP.



DUSTEX CORP.

P. O. BOX 2520 • BUFFALO 25, N. Y.

City vs. Home Incinerators? There's No Battle At All!

Editor:

Your editorial in the August, 1959, issue, "Municipal vs Residential, Apartment House Incineration . . . The Battle is On!", is rather perplexing and assumes apparently that the performance of one Class of Incinerator does not equal that of another.

Logically, the only answer to the combustible refuse disposal problem is to destroy the refuse at its source with Incinerators that function without nuisance. A home owner in most cases will burn combustible rubbish on his premises because he has no alternative. To help him do this effectively, a modern Incinerator can be of immense value. It *will* serve to eliminate odors, smoke and fly ash—all three. Certainly, in apartment building areas, the most outstanding example of this need to burn at the source is to be seen in Manhattan's streets already crowded with refuse collection trucks creating not only traffic jams but adding to the health hazards by the refuse spilled onto the sidewalks and streets.

While basically the refuse should be consumed at its source, it should also be recognized that some collection will be required according to the needs of each community and a so-called municipal or Class V Incinerator may still be required as *supplementary equipment* to "on-the-premise disposal" in residential, commercial and industrial Incinerators. THERE IS NO BATTLE AT ALL!!

Both domestic and Municipal Incinerators, however, can be neglected once they have been installed. Air pollution caused directly by incineration is almost always the result of bad equipment or bad maintenance at one point or another. On the other hand, soundly made equipment that is adequately serviced and maintained offers the key to incineration that will almost never create violations or cause ill will (no piece of mechanical equipment is ever fool-proof).

May we also call your attention to the fact that the greatest progress and successful operation in the Incinerator industry has been

(Please turn to page 4)

Climate by Chrysler

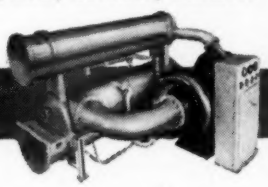
500 tons of cooling power from a 400-hp motor brings double savings to new Greenville Auditorium

A 500-ton Chrysler Centrifugal Liquid Chiller is the heart of the air conditioning system in the new Memorial Auditorium in Greenville, S. C. It cost less to install . . . and every second it operates, it's saving more money. Here's why:

Chrysler's exclusive true volute compressor casing design reduces horsepower requirements per ton of air conditioning. So Greenville saved money on initial costs by using a 400-hp motor . . . instead of the 450- to 500-hp motor needed by similar units. Operating costs are lower, too . . . because the smaller motor takes less power.

Whether there are 7,000 people—or 700—inside the auditorium, this versatile system handles the load perfectly. With Chrysler's exclusive adjustable guide vanes, output of the system can be reduced to 10% of maximum capacity, providing the most economical operating conditions for any size audience.

No matter how large the air conditioning job, Chrysler Liquid Chiller equipment can be custom-engineered to your needs. For complete information, contact your local Chrysler Applied Machinery and Systems sales office. Or write: Airtemp Division, Chrysler Corporation, Dept. AA-109, Dayton 1, Ohio. In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario.



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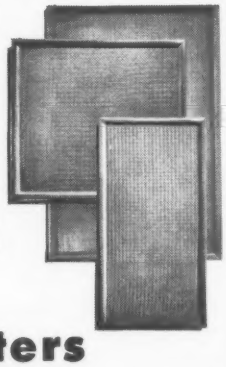
fresher
purer air

A day to remember. The sweep of sky and water . . . the fresh, clean feel of sea air. Air as clean and pure in a home? Certainly. Install Dust-magnet filters. Dust-magnets are electrostatic, *permanent* . . . rinse clean in a jiffy for immediate replacement in air conditioners and furnaces. Non-clogging, no oil coatings. As you live and *breathe* . . . install Dust-magnets!



DUST-magnet filters

3383 E. Layton Ave., Cudahy, Wisconsin

a product of STODDARD INDUSTRIES

Letters

(Continued from page 2)

in the household or Class I Incinerator. The premise that such units could operate faulty is badly taken for any piece of mechanical equipment can operate faulty. It is the householder himself who would best "police" the operation of his neighbor's Incinerator. Domestic Incinerators have long passed the laboratory stage and reached the stage of acceptance in the field. Consider what could be more disastrous than an improperly operated cozy fireplace? Yet not one word from air pollution people on this actually useless piece of household equipment.

Richard Goder, President
Incinerator Institute of America
New York City.

Editor:

To date we have received July and August issues of your publication AIR ENGINEERING. We like it very much, also the style and presentation of items and subjects.

We hope that all of our dealers and industry associates will subscribe to and faithfully read AIR ENGINEERING. It will certainly contribute to their knowledge and to the upgrading of the air conditioning industry.

The main thing, we feel, is to get the publication into the hands of our trade. They certainly need the good information conveyed.

L. A. Cox
Lac-Aircon Sales
Portland, Oregon

Editor:

We are writing all of our manufacturers representatives, recommending that they subscribe to AIR ENGINEERING.

H. O. Hazel
President
Dustex Corp.
Buffalo, N. Y.

Editor:

Like your magazine very much.

Gerald S. Bataille
President
Bataille, Kane & McKie, Inc.
Consulting Engineers
Chicago, Illinois

(Please turn to page 6)

. . . in dry dust control

proved DUCLONE® features assure

- ***HIGHER** efficiency*
- ***LONGER** service life*
- ***LOWER** operating cost*

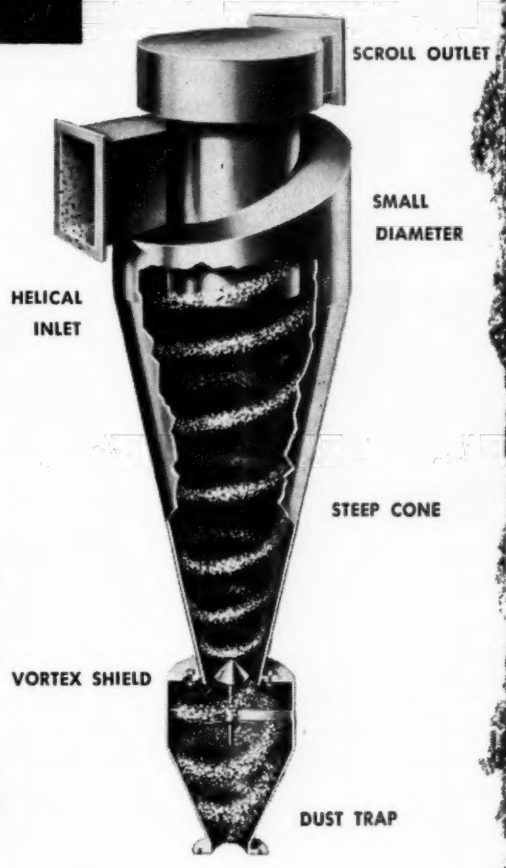
Duclones—Ducon high efficiency cyclones—are designed and constructed for high efficiency and low gas resistance so that maximum recovery of industrial dusts is obtained at the lowest possible cost. Their sturdy construction assures long, continuous service with a minimum of maintenance.

The exceptional performance of Duclone collectors is the result of these 6 unique features:

1. Small Diameter produces high efficiency
2. Helical Roof provides a turbulence-free path for the entering gas stream
3. Steep Cone improves dust separation
4. Dust Trap assures efficient dust removal from the cone
5. Vortex Shield prevents re-entrainment of dust in upward gas vortex
6. Scroll Outlet provides a low resistance clean gas outlet

Duclones are available in single and multiple units and in special materials of construction.

For complete information send for Bulletin C-958.



DUST CONTROL SYSTEMS AND EQUIPMENT — DUCON

the name in DUst CONtrol

THE Ducon COMPANY INC.
147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

Canadian Branch:
THE DUCON COMPANY of CANADA, Ltd.,
1131 Pettit St., BURLINGTON, ONTARIO

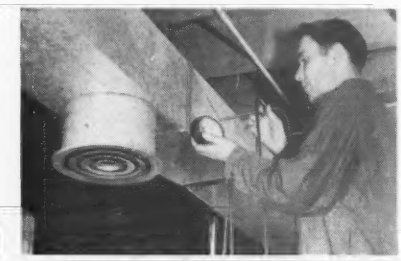
CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

Dwyer

Accuracy at a glance

STAINLESS STEEL PITOT TUBES

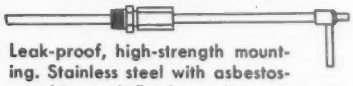
INCH-SCALED TO SHOW DEPTH OF INSERTION



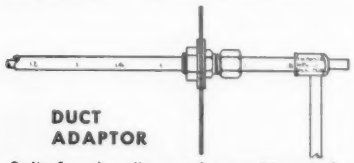
Dwyer No. 160 Pitot Tube being used to check air velocity with a No. 1010-1 Magnehelic Gage.

With inch graduation inscribed on *both* sides of the Dwyer Pitot Tube, you find the exact center of any duct immediately and make an accurate traverse. These Dwyer units feature lifetime stainless steel construction, accurate burr-free static holes and test-confirmed unity coefficients. They're available in a complete range of sizes from 12" to 60". With the mounting accessories shown below, they can be used for checking air velocities and static pressures in any kind of service. Dwyer Pocket-Size Air Velocity Calculator supplied with each Pitot Tube.

PACKING GLAND MOUNT



Leak-proof, high-strength mounting. Stainless steel with asbestos-graphite seal. For hazardous gases, etc.



DUCT ADAPTOR

Split ferrule allows tube position to be changed without disconnecting. Solid brass construction.

SPLIT FLANGE MOUNT

Split halves, neoprene gasket and hardware supplied for attaching to any duct. Fits all standard pitot tubes.

F. W. DWYER MFG. CO.

P.O. Box 373-A Michigan City, Ind.

Letters

(Continued from page 4)

Editor:

AAF as it stands today covers the field of Air Pollution Control, Air Moving, Air Conditioning and Industrial Ventilation. No other one company covers this particular range of interests and we have always felt that this was a very potent line-up. Now along comes a new magazine which covers this identical spectrum of interests,—it is AIR ENGINEERING by Business News Publishing Co., 450 West Fort Street, Detroit 26, Michigan. The first several issues look great. If the quality holds up it ought to be well worth the subscription price of $3.00 per year.

from "Marketing"
a publication of
American Air Filter Co., Inc.

Editor:

Please send a copy of your August 1959 issue of AIR ENGINEERING magazine to the attention of the writer.

I have heard that you have written a very excellent article on "Techniques for Laboratory Ventilation," and would like to have several copies if available.

George C. Lehmann
Project Engineer
Shampaine Company
St. Louis

Editor:

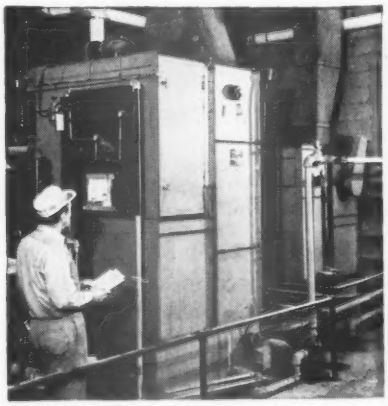
I have just read my first copy of your new magazine (June issue) and am pleased and enthusiastic over the arrival of a magazine of this scope on the engineering scene. It fills a very definite need, and I wish you every success in your venture.

At Lynchburg Foundry Company I have worked rather extensively in the field of ventilation and am keenly interested in the subject. I certainly am looking to your magazine as an excellent source of information and ideas in this field.

W. H. Puryear, Engineer
Lynchburg Foundry Company
Lynchburg, Va.

DRY and CLEAN AIR at the RIGHT TEMPERATURE

- to control your product quality
- to protect a critical operation
- to protect apparatus from moisture damage
- to DRY your material or product
- to control packing or storage conditions
- to assure precision in testing or research
- to increase air conditioning capacity



Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent

This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because...the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions... no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because...you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

NIAGARA BLOWER COMPANY

Dept. AIR-10, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada